ATTACHMENT 1

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INTERNATIONAL CLIMATE CHANGE PROGRAMS

Lessons Learned from the European Union's Emissions Trading Scheme and the Kyoto Protocol's Clean Development Mechanism

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GAO Accountability·Integrity·Reliability

Highlights

Highlights of GAO-09-151, a report to congressional requesters

INTERNATIONAL CLIMATE CHANGE PROGRAMS

Lessons Learned from the European Union's Emissions Trading Scheme and the Kyoto Protocol's Clean Development Mechanism

Why GAO Did This Study

International policies to address climate change have largely relied on market-based programs; for example, under the European Union's Emissions Trading Scheme (ETS) phase I (2005 to 2007) carbon dioxide emissions reductions were sought by setting a cap on each member state's allowable emissions and distributing tradable allowances to covered entities, such as power plants. Beginning operation in 2002, the Kyoto Protocol's Clean Development Mechanism (CDM) has relied on offsets, allowing certain industrialized nations to pay for emission reduction projects in developing countries—where the cost of abatement may be less expensive—in addition to reducing emissions within their borders.

Legislative proposals to limit greenhouse gas emissions are under consideration in the United States. In this context, GAO was asked to examine the effects of and lessons learned from (1) the ETS phase I and (2) the CDM. GAO worked with the National Academy of Sciences to identify experts in market-based programs and gathered their opinions through a questionnaire, interviewed stakeholders, and reviewed available information.

What GAO Recommends

GAO is not recommending executive action. However, in deliberating legislation for emissions trading, Congress may wish to consider the lessons learned from the ETS and the CDM.

To view the full product, including the scope and methodology, click on GAO-09-151. For more information, contact John B. Stephenson at (202) 512-3841 or stephensonj@gao.gov.

What GAO Found

According to available information and experts, the ETS phase I established a functioning market for carbon dioxide allowances, but its effects on emissions, the European economy, and technology investment are less certain. Nonetheless, experts suggest that it offers lessons that may prove useful in informing congressional decision making. By limiting the total number of emission allowances provided to covered entities under the program and enabling these entities to sell or buy allowances, the ETS set a price on carbon emissions. However, in 2006, a release of emissions data revealed that the supply of allowances—the cap—exceeded the demand, and the allowance price collapsed. Overall, the cumulative effect of phase I on emissions is uncertain because of a lack of baseline emissions data. The long-term effects on the economy also are uncertain. One concern about design and implementation was that the economic activities associated with emissions from covered entities would shift from the European Union to countries that do not have binding emission limits—a concept known as leakage. However, leakage does not appear to have occurred, in part because covered entities did not purchase allowances but received them for free. The effect of the ETS on technology investment also is uncertain but was likely minimal, in part because phase I was not long enough to affect such investments. Phase I of the ETS offers three key lessons: (1) accurate emissions data are essential to setting an effective emissions cap; (2) a trading program should provide enough certainty to influence technology investment; and (3) the method for allocating allowances may have important economic effects, namely, free allocation may distribute wealth to covered entities whereas auctioning could generate revenue for governments.

According to available information and experts, the CDM has provided flexibility to industrialized countries with emission targets and has involved developing countries in efforts to limit greenhouse gas emissions, but the program's effects on emissions are uncertain, and its effects on sustainable development have been limited. Nonetheless, the CDM's effects reveal key lessons that can help inform congressional decision making. Specifically, the CDM has provided a way for industrialized countries to meet their targets that may cost less than reducing emissions at home; however, available evidence suggests that some offset credits were awarded for projects that would have occurred even in the absence of the CDM, despite a rigorous screening process. Such projects do not represent net emission reductions and can compromise the integrity of programs—including the ETS—that allow the use of CDM credits for compliance. We also found that the cost-effectiveness and overall scale of emission reductions are limited by the current project approval process, although proposed changes may improve its effectiveness. Key lessons from the CDM include: (1) the resources necessary to obtain project approval may reduce the cost-effectiveness and quality of projects; (2) the need to ensure the credibility of emission reductions presents a significant regulatory challenge; and (3) due to the tradeoffs with offsets, the use of such programs may be, at best, a temporary solution.

Contents

Abbreviations

CER	Certified Emissions Reduction
CDM	Clean Development Mechanism
EU	European Union
ERU	Emission Reduction Unit
ETS	Emissions Trading Scheme
EUA	European Union Allowance
IPCC	Intergovernmental Panel on Climate Change
JI	Joint Implementation
NAS	National Academy of Sciences
UN	United Nations
UNFCCC	United Nations Framework Convention on Climate Change

United States Government Accountability Office
Washington, DC 20548

November 18, 2008

The Honorable Joe Barton
Ranking Member
Committee on Energy and Commerce
House of Representatives

The Honorable John Shimkus
Ranking Member
Subcommittee on Oversight and Investigations
Committee on Energy and Commerce
House of Representatives

The Honorable Darrell Issa
Ranking Member
Subcommittee on Domestic Policy
Committee on Oversight and Government Reform
House of Representatives

In 2005, the European Union's (EU) member states implemented the world's largest program to limit emissions of carbon dioxide—the most significant greenhouse gas—from the electric power and certain industrial sectors of their economies. The program, known as the Emissions Trading Scheme (ETS), relies on a cap-and-trade model similar to that used in the United States to limit airborne emissions of sulfur dioxide that cause acid rain and is the first international carbon dioxide trading program. Under the ETS, the EU member states determine the total amount of allowable carbon dioxide emissions, distribute these allowances to covered entities such as power plants, oil refineries, and other manufacturing facilities, and enable these covered entities to trade allowances. The first trading period—phase I—ran from 2005 to 2007; the second phase, currently underway, runs from 2008 to 2012.[1] Some observers view the ETS as a flexible and cost-effective tool to reduce emissions. Alternatively, other observers have said that the first ETS phase did not decrease emissions, imposed high costs on industrial entities and consumers, and may adversely affect the international competitiveness of European industries. As the U.S. Congress considers legislation intended to

[1]Although the law, or directive, establishing the ETS uses the term "period" to refer to 2005 to 2007 and subsequent 5-year periods, in practice the EU refers to the 2005 to 2007 period as a learning phase, or phase I, and the 2008 to 2012 period as phase II. We use the EU's terminology in this report.

address climate change, the EU's experience implementing the ETS may prove useful in informing Congress's decisions.

The EU's implementation of the ETS stems from commitments its member states and the EU made under the Kyoto Protocol (the Protocol), an international agreement to minimize the adverse effects of climate change, which was developed within the United Nations Framework Convention on Climate Change (UNFCCC).[2] To date, 182 countries—including all of the EU member states—have ratified the Protocol, which set binding emissions targets for 37 industrialized countries and the European community, covering carbon dioxide and five other greenhouse gases.[3] For context, the EU member states collectively ranked as the world's third- largest emitter of carbon dioxide in 2004, behind the United States and China.[4] The U.S. signed the Protocol in 1998 but is not bound by the Protocol's terms because it was not submitted to the Senate for ratification and therefore has not been ratified.

The Protocol identifies several mechanisms available to help meet the binding targets, including emissions trading and the Clean Development Mechanism (CDM).[5] Emissions trading allows countries with emissions lower than the level specified in the Protocol to sell excess allowances to countries with emissions exceeding their Kyoto targets, thereby creating a

[2]The UNFCCC's ultimate objective is to achieve stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic (man-made) interference with the climate system within a time frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened, and to enable economic development to proceed in a sustainable manner. It was ratified by the United States, 190 other nations, and the European Economic Community.

[3]The six primary greenhouse gases are carbon dioxide, methane, and nitrous oxide, as well as three synthetic gases including hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride. The remaining signatories to the Protocol were not required to decrease their emissions but were required, among other things, to monitor and report their emissions in accordance with the UNFCCC.

[4]GHG Emissions, Yearly Emissions Inventory, in the World Resource Institute's Climate Analysis Indicators Tool, Version 5.0. (Washington, D.C., World Resources Institute, 2008). The 2004 estimate excludes emissions from land use changes as well as from Bulgaria and Romania, which joined the EU in 2007.

[5]Under the Protocol, the use of these mechanisms must supplement domestic action for the purpose of meeting the country's emission limitation or reduction commitment (i.e., a binding emissions target). The third mechanism, Joint Implementation, operates under similar principles as the CDM, although it involves emission reduction projects in industrialized, rather than developing, countries. To date, activity under the Joint Implementation provisions of the Protocol has been limited.

commodity in greenhouse gases (known as a carbon market). Emissions trading can help minimize abatement costs by enabling covered entities that face relatively high costs in reducing their emissions to buy excess allowances from other entities with lower-cost opportunities.

The CDM allows countries with binding targets under the Protocol to implement projects that reduce or avoid emissions—such as the construction of renewable energy infrastructure—in a developing country that does not have a binding emissions target under the Protocol. The logic of the CDM is that it provides a cost-effective way for industrialized nations to reduce emissions of greenhouse gases, which may cost less in developing nations, while also promoting sustainable development in countries that host projects. CDM projects earn credits, each equivalent to 1 metric ton of carbon dioxide, that an industrialized country sponsoring the project can sell or use for compliance with its Kyoto target. These credits are known as Certified Emissions Reductions (CER) or simply as "carbon offsets."[6]

In accordance with the Protocol, CDM projects must meet several key requirements. For example, CDM projects must provide real, measurable, and long-term benefits related to the mitigation of climate change. In addition, projects need to achieve reductions beyond any that would occur in absence of the CDM, a concept known as "additionality." Before credits are issued, projects must undergo review by national officials of the country where the project occurs and have an external party validate documentation and verify emission reductions. The Executive Board, a UNFCCC regulatory body established by the Protocol, is responsible for supervising the CDM.

The Protocol requires industrialized countries to achieve their binding targets between 2008 and 2012. Recognizing this requirement, the EU government enacted a law, known as a directive, to establish the ETS, a market-based emissions trading program through which member states would reduce their carbon dioxide emissions while minimizing any adverse effects on economic development and employment.[7] The ETS

[6]A key distinction in the carbon offsets markets involves whether the offsets are purchased for compliance with mandatory emissions limits, such as those in the EU or on a voluntary basis in countries that do not have binding limits on emissions. The two markets often are referred to as "compliance" and "voluntary" markets. See GAO, *Carbon Offsets: The U.S. Voluntary Market Is Growing but Quality Assurance Poses Challenges for Market Participants*, GAO-08-1048 (Washington, D.C.: Aug. 28, 2008) for an overview of the U.S. voluntary offset market.

[7]Directive 2003/87/EC, 2003 O.J. (L 275) 23.

began with the first phase to gain experience with emissions trading before the Protocol's 2008 to 2012 commitment period and operated phase I from 2005 to 2007. Phase I included approximately 11,000 electric power and industrial installations in 25 member states, which accounted for about half of the EU's carbon dioxide emissions.[8]

Under the ETS, each member state was required to propose its own carbon dioxide emissions cap and allocation scheme in a National Allocation Plan. The ETS Directive established some general criteria for the National Allocation Plans but gave member states flexibility in how they determined their cap and methods for allocating allowances—such as free distribution or auctioning—to covered entities. For phase I, the EU directive allowed member states to auction up to 5 percent of their allowances, but 21 member states chose to distribute all allowances free of charge. After documenting the cap and allocation plan in its National Allocation Plan, each member state submitted it to the European Commission—the EU's executive branch—for approval. The aggregated national caps from the 25 approved National Allocation Plans represented the total level of emissions allowed from facilities covered under the ETS, also referred to as the cap.

Under the ETS, covered entities trade carbon dioxide allowances (known as European Union Allowances, or EUAs) with other covered entities; entities that are not covered under the ETS also may trade EUAs if they set up a trading account in a member state's registry, an electronic system that tracks ownership of allowances. To further minimize costs, covered entities are allowed to purchase a limited number of CDM credits (CERs) and use them toward compliance with their caps. Covered entities can trade EUAs and CERs in several ways. For example, they may buy and sell directly with one another or use exchanges and other trading platforms operated by third parties. Trading activity in CERs and EUAs has increased steadily in the past several years and accounted for nearly all of the financial value of the global carbon market in 2007. According to the World Bank, the financial value of EUAs and CERs totaled about $63 billion in 2007, of which approximately $50 billion consisted of EUAs and $13 billion consisted of CERs.[9]

[8]In addition to electric power production, the industries covered included oil refining, iron and steel, cement, glass, and pulp and paper manufacturing. Bulgaria and Romania began participating in the ETS when they each joined the EU in 2007. Phase II also includes Norway, Iceland, and Liechtenstein, which are members of the European Economic Area.

[9]World Bank, *State and Trends of the Carbon Market 2008* (Washington, D.C., 2008).

An examination of the environmental, economic, and technological effects of the first ETS phase and the CDM provides a number of useful lessons that could inform decision making in the United States, where numerous legislative proposals to limit greenhouse gas emissions are under consideration. Within this context, we examined (1) what experts and available information indicate about the effects of the EU ETS phase I and the lessons learned that can inform congressional deliberation on climate change policies, and (2) what experts and available information indicate about the effects of the Kyoto Protocol's CDM and the lessons learned that can inform congressional deliberation on climate change policies.

To respond to these objectives, we reviewed information on the ETS and CDM available from the EU, the UN, the academic literature, and market research firms. We also conducted semistructured interviews with international government officials; industry representatives; environmental advocacy organizations; market traders; researchers; and owners, developers, and auditors of CDM projects. Following our data collection and interview process, we then collaborated with the National Academy of Sciences (NAS) to recruit a panel of experts to assist in identifying the key themes and lessons learned from the ETS and CDM that could influence decision making in the United States. The 26 experts were recruited based on their experience and expertise with international climate change programs and their knowledge of the U.S. policy development process. We engaged the experts using a Web-based questionnaire that included both open- and closed-ended questions. Finally, we identified important themes through a content analysis of responses to the open-ended questions, and summarized responses to the closed-ended questions. We conducted our work from October 2007 to November 2008.

Results in Brief

According to available information and experts, the primary effect of the first ETS phase was to establish a functioning carbon market for allowances, but its effects on emissions, the European economy, and technology investment are less certain. Nonetheless, experts suggest that phase I offers important lessons that can inform congressional decision making. Specifically:

- *Effects*. The primary effect of the first ETS phase was to establish a functioning carbon market for allowances. By limiting the total number of allowances under the program and enabling covered entities to sell or buy allowances to cover their emissions, the ETS used market forces to set a price on carbon emissions that fluctuated based on changes in supply and demand. Accordingly, the price collapse after the release of emissions data in 2006 showed that phase I was overallocated—the cap exceeded actual emissions. That is, the supply of allowances was greater than the demand. This resulted primarily from uncertainty surrounding the data used to set the emissions cap and distribute allowances. Moreover, the ETS's cumulative effect on emissions across the EU member states is uncertain. While several researchers and about half of the experts concluded that the ETS resulted in a cumulative decrease in emissions compared to a business-as-usual scenario, the European Commission told us that data limitations preclude definitive conclusions about the ETS's effect during phase I. Overallocation of allowances posed challenges in assessing the program's long-term economic effects—in particular whether economic activities associated with emissions of covered entities shifted to countries that have not adopted binding emissions limits, a concept known as leakage. According to available information, leakage did not likely occur because, for example, facilities received allowances for free, based on projected emissions, and the cap exceeded emissions. In addition, the effect of the first ETS phase on technology development and innovation is uncertain but likely minimal in part because the compressed trading phase did not provide enough time to affect investments in clean technology. The price collapse of carbon allowances also reduced the incentive for covered entities to invest in new technologies.

- *Lessons learned.* According to available information and experts, the ETS revealed lessons about three key aspects of phase I, including data requirements for setting an effective emissions cap, how program design features may influence the effectiveness of emissions trading, and about the economic impacts. First, accurate emissions data are essential to setting an effective emissions cap and achieving the intended environmental objectives. Second, a trading program should cover a long enough time period to influence technology investment decisions. Third, the ETS demonstrated that the method of allowance allocation can have important effects for government and regulated industries. For example, free allocation can create and transfer substantial amounts of wealth to program participants whereas an auction may generate revenue that governments can use for a variety of purposes, such as reducing the tax burden for low-income individuals or supporting research and development of less-carbon-intensive technologies.

According to available information and experts, the CDM has helped industrialized countries make progress toward achieving their emissions targets at less cost, and has involved developing countries in these efforts, but the program's effects on emissions are uncertain and its impact on sustainable development has been limited. Moreover, the cost-effectiveness of emission reductions achieved by the program and the overall scale of these reductions are limited by the existing project approval process, although proposed improvements may address these challenges. Key lessons from the international experience with the CDM could help inform congressional decision making. Specifically:

- *Effects*. The CDM can lower costs for nations with binding targets under the Kyoto Protocol and entities covered by the EU ETS by allowing them to earn credits for projects that cut emissions in developing nations, where reductions may be cheaper, and use these credits toward their emission target or cap. The CDM also has involved developing nations, primarily China and India, in the global carbon market by providing them with experience in emissions trading. Overall, the net effect of the CDM on international emissions is uncertain, in part because it is nearly impossible to ensure that projects are additional—that is, that the emission reductions would not have occurred in the absence of the CDM. The UN has implemented a lengthy, rigorous review process, and while this process may provide greater assurance of credible projects, available evidence suggests that some credits have been issued for emission reduction projects that were not additional. Nonadditional projects, in turn, can compromise the integrity of programs that allow the use of CDM credits for compliance, such as the ETS, because these projects allow covered entities to increase their emissions without a corresponding reduction in a developing country. In addition, the overall effect of the CDM on sustainable development has been limited, although available information indicates a modest impact on technology transfer. Finally, many stakeholders and experts expressed concern that the CDM's approval process was unclear, impractical, and resource intensive, and some said that the extensive requirements have deterred otherwise legitimate projects. However, recognizing the potential benefits of the CDM, the experts recommended possible reforms and alternatives to more effectively achieve the CDM's goals, including streamlining the measurement and review processes, targeting the CDM toward certain countries and industry sectors, and providing incentives for developing countries to set their own emission targets.

- *Lessons learned*. The international experience with the CDM has provided key lessons regarding the cost-effectiveness and environmental effects of offset programs, as well as the tradeoffs that can occur as a result of their use. First, while the CDM may reduce compliance costs for covered entities, it may not be a cost-effective means of achieving emission reductions in developing nations, due primarily to high transaction costs imposed on project participants. Second, it is important to ensure that each project represents real, measurable emission reductions, and that nonadditional projects are not used in lieu of real reductions mandated by a cap-and-trade program. Due to inherent challenges in measuring offsets, however, it may be difficult to provide such assurances. Finally, while proposed improvements may help to streamline the CDM and improve its effectiveness, offset programs present significant tradeoffs for mandatory emission reduction programs that use them for compliance, and therefore may be best used as a temporary means to help transition developing countries into a more comprehensive climate change strategy.

We are not recommending executive action. However, in deliberating legislation intended to limit greenhouse gas emissions through emissions trading and the use of carbon offsets, congress may wish to consider lessons learned from the ETS and CDM. Regarding emissions trading, Congress may wish to consider (1) the importance of ensuring the availability and reliability of historic emissions data, (2) the need for long-term certainty to encourage investments in less-carbon-intensive technologies, and (3) how the means of distributing allowances to emit greenhouse gases—such as free allocation versus auctioning—create and redistribute substantial wealth.

Regarding the CDM and use of offsets for compliance, Congress may wish to consider: (1) that it may be possible to achieve the CDM's sustainable development goals and emissions cuts in developing countries more directly and cost-effectively through a means other than the existing mechanism; (2) that the use of carbon offsets in a cap-and-trade system can undermine the system's integrity, given that it is not possible to ensure that every credit represents a real, measurable, and long-term reduction in emissions; and (3) that while proposed reforms may significantly improve the CDM's effectiveness, carbon offsets involve fundamental tradeoffs and may not be a reliable long-term approach to climate change mitigation.

Background

Greenhouse gases—including carbon dioxide, methane, nitrous oxide, and synthetic chemicals such as fluorinated gases—trap heat in the atmosphere and prevent it from returning to space. The heat-trapping effect, known as the greenhouse effect, moderates atmospheric and surface temperatures, keeping the earth warm enough to support life and varies depending on the gas. Each unit of the non-carbon-dioxide gas generally has a greater warming effect than each unit of carbon dioxide, although carbon dioxide is the most prevalent anthropogenic greenhouse gas and has the greatest overall effect on warming.[10] According to the Intergovernmental Panel on Climate Change (IPCC)—an organization within the UN that assesses scientific, technical, and economic information on the effects of climate change—global atmospheric concentrations of these greenhouse gases have increased markedly as a result of human activities over the past 200 years, contributing to a warming of the earth's climate.

Climate change is a long-term and global issue because greenhouse gases disperse widely in the atmosphere once emitted and can remain there for an extended period of time. Among other potential impacts, climate change could threaten coastal areas with rising sea levels, alter agricultural productivity, and increase the intensity and frequency of floods and tropical storms. The effect of increases in atmospheric concentrations of greenhouse gases and temperature on ecosystems and economic growth is expected to vary across regions, countries, and economic sectors.

One of the greatest challenges underlying policies to address climate change is reducing greenhouse gases while meeting rising energy demands. Energy demands are met largely through fossil fuel combustion, which releases greenhouse gases—primarily carbon dioxide. In fact, fossil fuel combustion accounts for the largest share of growth in greenhouse gas emissions, according to the IPCC. For example, greenhouse gas emissions from electricity and heat production grew 145 percent between 1970 and 2004; emissions from road transportation increased 120 percent. Other sources of greenhouse gas emissions include agricultural activities, transportation, forestry, waste management, and residential and commercial activities.

According to the IPCC, in 2004, developed countries, including the United States, constituted 20 percent of global population, but were responsible for nearly half of global greenhouse gas emissions. The total emissions from some developing countries, which have lower per capita emissions but larger populations, have begun to approach the total emissions from developed countries, which tend to have higher per capita emissions and smaller populations. Recent economic development in nations such as

[10] Water vapor is also a greenhouse gas. According to the IPCC, water vapor is the most abundant and important greenhouse gas in the atmosphere, but human activities have a small direct influence on the amount of water vapor present in the atmosphere.

China and India has reduced poverty but also has increased energy use, which has caused rapid growth in emissions. In the absence of mitigation policies[11]—i.e., policies that would reduce greenhouse gas emissions—the IPCC projects that between 2000 and 2030, two-thirds to three-quarters of the projected increase in global carbon dioxide emissions will occur in developing countries, although per capita emissions will remain substantially lower than those of developed countries.[12] The IPCC also projects that compared to 2000, global greenhouse gas emissions will increase between 25 percent and 90 percent by 2030 in the absence of new climate mitigation policies.

According to the IPCC, climate mitigation policies are essential to facilitate a transition to a less-carbon-intensive energy infrastructure and stabilize the climate. In the short term, policies designed to increase energy efficiency or induce a switch to less-carbon-intensive fuels, such as from coal to natural gas, can reduce emissions. In the long term, however, major technology changes will be needed to establish a less-carbon-intensive energy infrastructure. To that end, climate mitigation policies may require facilities to achieve specified reductions or provide an incentive to reduce emissions by, for example, establishing a price on emissions. The policies that set a price on emissions, also known as market-based programs, include emissions trading and emissions taxes.

The cost for facilities to reduce emissions depends on numerous factors that may vary by facility, such as the age of capital equipment. Under an emissions trading program, the cost of an allowance to emit greenhouse gases influences each facility's decision about whether and how much to reduce emissions. Because reduction costs vary among the facilities, some will choose to reduce emissions and sell excess allowances while others will opt to purchase allowances to cover emissions. According to economic theory, this will result in reductions at the facilities with the

[11]The IPCC defines mitigation as technological change and substitution that reduce resource inputs, such as energy use, and emissions per unit of output. Although several social, economic, and technological policies would produce an emissions reduction, with respect to climate change, mitigation means implementing policies to reduce greenhouse gas emissions and enhance greenhouse gas sinks.

[12]IPCC, 2007: Introduction. In: Climate Change 2007: Mitigation, Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change (B. Metz, O.R. Davidson, P.R. Bosch, R. Dave, L.A. Meyer [eds.]), Cambridge University Press, Cambridge, United Kingdom. http://www.mnp.nl/ipcc/pages_media/AR4-chapters.html (accessed Oct. 31, 2008).

lowest costs. As the emissions cap becomes stricter, the supply of allowances decreases and causes prices to rise. As a result, the incentive to reduce emissions increases. In short, the allowance price is key to achieving a net reduction in emissions.

A problem may arise, however, if economic activity similar to that covered under one country's market-based program is not likewise subject to binding carbon limits in another country. This can lead to the movement of economic activities associated with emissions from countries that have adopted binding emissions limits to countries that have not done so. This geographic displacement of emissions is a concept known as leakage. Overall, leakage could impede progress toward the environmental objectives of a market-based program by shifting emissions to areas without a binding carbon limit. As allowance prices rise, production may be shifted abroad to existing competitors or new firms; in addition, covered entities may shift some of their production to facilities that exist in countries without binding carbon dioxide limits.

Many countries, such as the member states of the EU, have begun to mitigate or reduce greenhouse gas emissions by adopting market-based policies such as carbon taxes, cap-and-trade programs, and offset programs, as well as other policies, including energy efficiency standards; voluntary agreements; education campaigns; and research, development, and deployment of advanced technologies. Governments also may use a portfolio of policies. For example, in the EU, a variety of measures are underway to reduce greenhouse gas emissions, including the ETS—its cornerstone—as well as measures to promote renewable energy sources, implement performance standards intended to improve energy efficiency in new buildings, and reduce carbon dioxide emissions from new passenger cars.

The EU—a unique economic and political partnership between 27 countries—is composed of multiple institutions, including three decision-making institutions.[13] Two bodies serve as the EU's legislative branch—the European Parliament, composed of representatives directly elected by EU citizens, and the Council of the European Union, composed of a representative from each member state. In the environmental field, both

[13]Other relevant institutions are the European Council and the European Court of Auditors. The European Council comprises the member states' heads of states (Presidents and Prime Ministers) and the President of the European Commission. The European Council is the initiator of the EU's major policies. The European Court of Auditors audits EU finances.

bodies must approve legislation for it to become law. However, neither branch can initiate legislation; they may act only on legislative proposals submitted by the European Commission, which is the EU's executive branch. Although each member state is represented on the Commission, Commission members serve the common EU interest rather than representing their member state.[14] In addition to proposing legislation, the Commission ensures proper implementation of EU directives, including those enacted as part of the European Climate Change Programme.[15] For example, the Commission proposed the ETS Directive to establish the Emission Trading Scheme, which was amended and then approved by the Parliament and Council, and has implemented it by approving member states' National Allocation Plans, helping to develop a system to track allowances, and assessing progress of the ETS, among other tasks. The Court of Justice of the European Communities has considered law suits brought by member states challenging the Commission's rejection of National Allocation Plans and by covered entities challenging various aspects of the ETS, but has otherwise not played a significant role with respect to the ETS.

EU Emissions Trading Scheme Established a Carbon Market and Provides Lessons That Could Inform U.S. Decision Making on Climate Change Policy

According to available information and experts, the primary effect of the first ETS phase was to establish a functioning carbon market for emissions allowances, but its effects on emissions, the European economy, and technology investment are less certain. In particular, data limitations make it impossible to know whether phase I reduced emissions below the level that would have occurred in the absence of the ETS. Nonetheless, experts suggest that phase I offers important lessons about program design and implementation that may prove useful in informing congressional decision making.

[14]Member states choose the President of the Commission by common accord and the European Parliament must then assent to the selection. Once in power, the Commission President chooses the other Commission members, one from each member state, with the assistance of member states' governments. Both the Council of the European Union and the European Parliament must approve of the President's choices.

[15]The European Climate Change Programme is a multistakeholder consultative process in which experts from the European Commission, member states, academics, industry and nongovernmental organizations address issues to improve the functioning and cost-effectiveness of the ETS, carbon capture and storage, and other climate policies.

Creation of the ETS Established a Market for Carbon Allowances

The primary effect of the first ETS phase was to establish a functioning carbon market for allowances in which emissions caps were set and allowances to emit carbon dioxide were distributed, bought, and sold. By limiting the total number of allowances under the program and enabling covered entities to sell or buy allowances to cover their emissions, the ETS used market forces to set a price on carbon emissions that fluctuated based on changes in supply and demand. For example, EU emissions allowances known as EUAs traded at €8.57 ($10.40) per metric ton of carbon dioxide on January 3, 2005; reached a peak price of €31.58 ($37.48) per metric ton on April 19, 2006; and then collapsed when the 2005 emissions data, which had been verified by third parties, showed that phase I was overallocated.[16] That is, the overall cap exceeded actual emissions—the supply of allowances was greater than the demand. The price collapse also resulted partially from the fact that covered entities were largely unable to carry unused allowances to the next trading phase, a concept known as banking.[17] The general prohibition on banking allowances, however, helped confine the overallocation to phase I because the member states set new caps in 2008 and issued new allowances.[18] Interperiod banking would have given covered entities an incentive to reduce emissions during phase I, despite overallocation, and to save unused allowances for a later trading phase, which had more stringent emissions caps.

Although the absolute supply of allowances did not change during phase I, the market's perception of the balance of supply and demand dramatically changed. Prior to the release of 2005 verified emissions data in the spring of 2006, ETS participants and market analysts expected a shortage of allowances, and allowance prices steadily increased. The release of

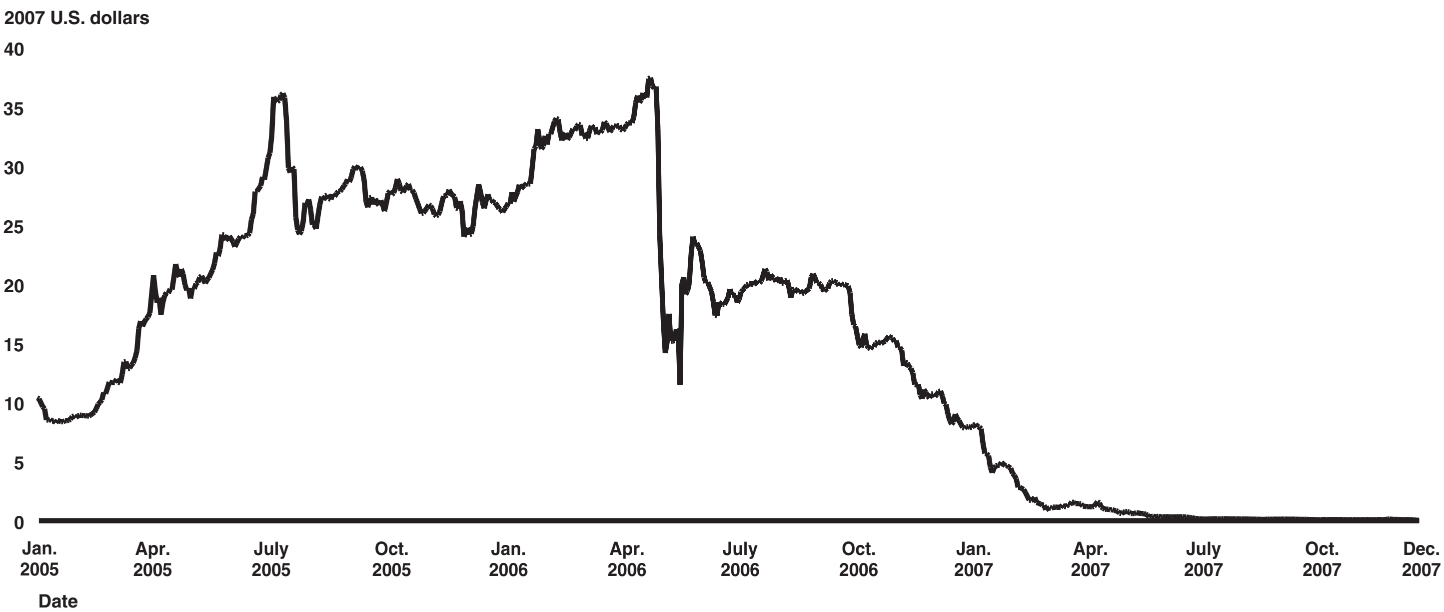
[16]EUA 2007 prices are in 2007 dollars. Prices, which were obtained from Point Carbon and adjusted for exchange rates (Purchasing Power Parity) and inflation, are based on spot and forward transactions. Most EUAs are traded on a forward basis, meaning that a purchaser may agree to buy an EUA at a certain price but would not pay and receive the allowance until, for example, 2007.

[17]The ETS Directive allowed member states to decide whether to permit banking from phase I to phase II. The Commission permitted banking phase I allowances to phase II if (1) they were unused because of abatement rather than overallocation and (2) banked allowances were subtracted from the member state's phase II cap. Poland was the only member state to allow banking to phase II.

[18]The ETS Directive automatically permitted banking from one year to another within the first phase because all allowances issued during phase I were valid for the duration of that trading period.

verified emissions data, however, showed that the 2005 emissions cap—i.e., the supply of allowances—exceeded actual emissions that year, causing the price collapse. See figure 1 for a graph displaying the allowance price trends in phase I.

Figure 1: EUA 2007 Prices



Source: Point Carbon (2007).

The demand for allowances, on the other hand, was influenced by covered entities' allowance allocation, the cost of carbon dioxide abatement options, and the level of carbon dioxide emissions over the course of phase I.[19] Specifically, the extent to which the initial free allocation covered each covered entity's emissions influenced demand throughout the ETS market. For example, some covered entities were in a net "short" position—they did not receive enough allowances from the free allocation to cover annual emissions—while others were in a net "long" position—they received a surplus of allowances. The covered entities that were short on allowances had to reduce emissions, purchase allowances, or both in order to comply with the ETS, whereas the long entities could sell or hold

[19]Convery, Frank and Luke Redmond, "Market and Price Developments in the European Union Emissions Trading Scheme," *Review of Environmental Economics and Policy*, vol. 1, no. 1 (2007).

onto the excess allowances.[20] The short and long positions of covered entities varied by industrial sector and among the member states.

With respect to industrial sectors, the demand for allowances came largely from the power sector. Most power generation facilities were short whereas industrial facilities, including iron and steel; manufacturing ceramics; and pulp, paper, and board manufacturing were long. Member states allocated the shortage to the power sector because they believed this sector could reduce emissions at a lower cost than covered entities in other sectors. In addition, there were concerns that compliance with the ETS would create costs for covered entities that compete with facilities outside the EU that are not subject to carbon limits. Therefore, member states generally allocated the surplus to the globally competitive industrial sectors and the shortage to the power sector, which does not generally compete with entities outside the EU.

With respect to member states, the net position of all covered entities was long in 19 of the EU member states and short in the rest of the member states.[21] Specifically, the net position of covered entities in Greece, Ireland, Italy, Spain, Slovenia, and the United Kingdom was short because the covered entities' annual emissions, on average, exceeded the number of allowances in the initial allocation. Accordingly, covered entities in these member states purchased allowances on the market to cover emissions beyond their allocation. The range of short and long positions of covered entities among the member states demonstrates that the stringency of the member states' caps may have varied. For instance, member states with covered entities in a net short position likely established more stringent caps than those with net long positions. Figure 2 shows which member states had covered entities with net short and net long positions.

[20]Although interperiod banking was generally not an option, intraperiod banking could give covered entities a reason to hold onto excess allowances if, for example, they expected prices to rise during the first phase.

[21]Net position based on the average in phase I of the annual net position in each member state, which reflected the difference between total allowances issued to covered entities and total allowances surrendered by covered entities. Analysis based on emissions data from the European Environment Agency's Community Independent Transaction Log Viewer. http://www.eea.europa.eu/themes/climate/citl-viewer (accessed Oct. 10, 2008). Excludes Bulgaria and Romania, which joined the EU in 2007.

Figure 2: Net Positions of Covered Entities in EU Member States in Phase I

Net long position (0% < 10% long)

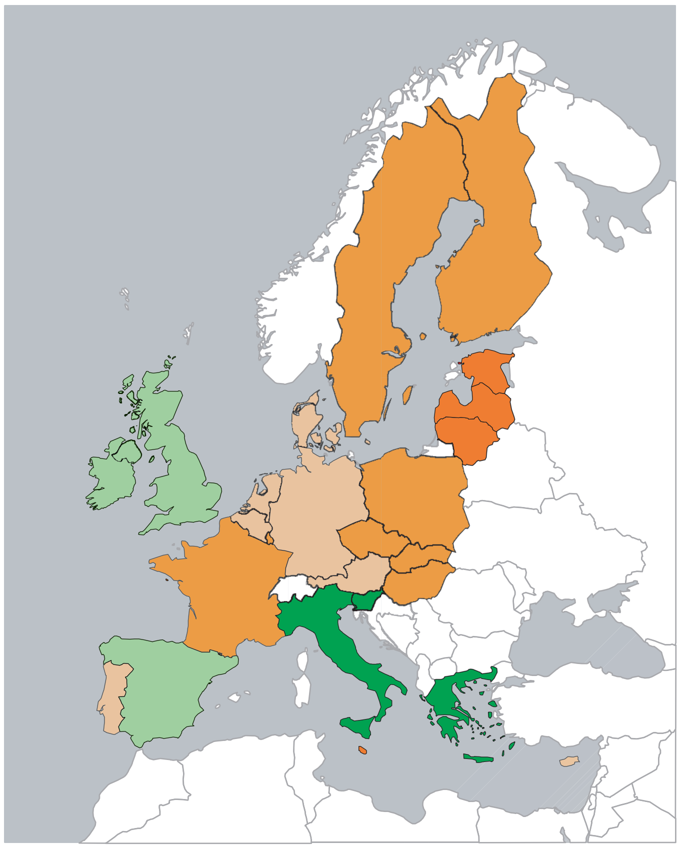
- Austria
- Belgium
- Cyprus
- Denmark
- Germany
- Netherlands
- Portugal

Net long position (10% ≤ 20% long)

- Czech Republic
- Finland
- France
- Hungary
- Luxembourg
- Poland
- Slovakia
- Sweden

Net long position (> 20% long)

- Estonia
- Latvia
- Lithuania
- Malta



Net short position (0% < 10% short)

- Greece
- Italy
- Slovenia

Net short position (10% ≤ 20% short)

- Ireland
- Spain
- United Kingdom

Source: GAO analysis; MapArt (illustration).

Furthermore, allowance data reveal that while most allowances were issued and used within the same member state, transfers of wealth from covered entities in short member states to those in long member states occurred in some cases where the entities did not have sufficient allowances to cover their emissions. One study showed that the United Kingdom imported EUAs to cover about 14 percent of its verified emissions, making it the largest net importer of EUAs in phase I.[22] According to this study, 17 member states were net exporters of allowances. The extent of exporting varied among these member states,

[22] Ellerman, A. Denny, *The EU Emission Trading Scheme: Prototype of a Global System?* Discussion paper 08-02 (Cambridge, Mass.: Harvard Project on International Climate Agreements, August 2008).

ranging from net exports that accounted for about 1 percent of total allowances to 34 percent. Overall, however, researchers have concluded that wealth transfers in phase I have been minimal but note this may change with increasingly ambitious targets in subsequent trading phases.

The Effect of ETS Phase I on Emissions Is Uncertain Because of Data Limitations

Although the first ETS phase was overallocated—the overall emissions cap exceeded actual emissions by more than 3 percent in phase I[23]—the ETS's cumulative effect on emissions across the EU member states is uncertain largely because of data limitations. First, there is an inherent uncertainty about how actual emissions compare to the emissions that would have occurred in the absence of the ETS. This is because it is impossible to forecast future emissions levels in a business-as-usual scenario with complete certainty. For example, emissions depend on numerous factors, such as fuel prices and economic conditions that vary and are difficult to predict. Second, the use of information about past emission trends can reduce the uncertainty of business-as-usual projections but historical, facility-specific data—i.e., baselines—were generally unavailable prior to phase I. The lack of baseline data made it more difficult to forecast business-as-usual emissions and therefore characterize the effect of the ETS on emissions. According to the Commission, the data limits preclude definitive conclusions about the impact of phase I on emissions.

The tight time frame to establish emission caps and the limited authority to collect baseline data from covered entities made it difficult to overcome these data limitations. Over the course of 6 months, each member state had to identify which entities to regulate under the ETS, obtain baseline emissions data for the covered entities, establish an emissions cap that would be consistent with its Kyoto target, and determine how many allowances to distribute to each covered entity. At the time, most member states had high-level, aggregated data on carbon dioxide emissions that accounted for sources within and outside the scope of the ETS. However, the member states did not have baseline data that broke out emissions on a facility-specific basis, which was necessary to determine both the total emissions released by all entities covered under the ETS as well as how many allowances each particular entity would need to cover its annual emissions. The member states took steps to obtain baseline data but,

[23]European Environment Agency, *Greenhouse gas emission trends and projections in Europe* (Copenhagen, Denmark, 2008).

according to the Commission, were constrained by the tight time frame and limited authority to collect data—some member states did not yet have in place a national law or regulation mandating submission of emissions data.[24]

The lack of historical baseline data therefore largely prohibited member states from basing their caps on average emissions over a sustained period of time preceding the program's establishment, an approach that the United States used successfully in establishing a cap-and-trade program for sulfur dioxide from power plants in response to the 1990 Clean Air Act amendments. The U.S. program used average emissions from 1985 to 1987 as the baseline against which to measure reductions required to begin in 1995 and 2000, thereby providing greater certainty that the program achieved reductions relative to past emissions levels. The use of a historical baseline in the sulfur dioxide program also reduced the covered entities' incentive to increase emissions prior to the program's establishment to obtain a greater allowance allocation—the baseline years occurred too far before the announcement of the program. Reliance on historical data spanning several years rather than one year also reduced the risk that the baseline did not represent typical emissions levels, which can vary across years due to economic conditions and price levels.[25]

In contrast, the EU member states generally based their emissions caps on business-as-usual projections and allocation decisions on recent baseline emissions data voluntarily submitted by covered entities. The inherent uncertainty of business-as-usual projections was compounded by the assumptions underlying the models used to forecast emissions. Specifically, the models incorporated assumptions about factors that influence business-as-usual emissions projections, such as economic growth and relative fuel prices. Some member states made relatively optimistic assumptions about economic growth, which resulted in higher projections of emissions. Regarding allocation decisions, member states used recent baseline emissions data submitted by covered entities, which meant that covered entities that released more carbon dioxide per unit of

[24]The ETS directive required member states to "bring into force the laws, regulations and administrative provisions necessary to comply" with the directive by December 31, 2003. This requirement would have included the national laws, regulations and policies the member states needed to ensure that the covered installations' emissions reports were submitted and verified.

[25]See GAO, *Air Pollution: Allowance Trading Offers an Opportunity to Reduce Emissions at Less Cost*, GAO/RCED-95-30 (Washington, D.C.: Dec. 16, 1994).

output received higher allotments than those with lower rates.[26] Some researchers have questioned the reliability of these data because of the potential incentive for covered entities to inflate emissions. According to one researcher, member states assessed the quality of the emissions data provided by covered entities by, for example, cross-checking it.

The uncertainties underlying phase I emissions caps were especially problematic because the reduction goals of the first phase were modest. It is worth noting, however, that phase I preceded the commitment period under the Kyoto Protocol (2008 to 2012) and moreover that the first phase was intended to simply gain experience with emissions trading before 2008. According to available information, member states intentionally established emission caps at levels near business-as-usual projections, which effectively left smaller room for error in determining emission levels.

While some ETS observers have concluded that emissions abatement under phase I was unlikely because the cap exceeded actual emissions, several researchers have concluded that the ETS resulted in a cumulative decrease in emissions compared to business as usual scenario.[27] The researchers stated that some covered entities likely reduced emissions by, for example, switching to cleaner fuels to generate power or improving energy efficiency, in response to the allowance price in the early stages of phase I. In addition, approximately half of the experts concluded that the first phase resulted in a cumulative decrease in emissions compared to a business-as-usual scenario. Several experts attributed the reduction to the allowance price, noting that it was likely high enough to encourage some abatement, and several others identified published research as the basis for their response. Several of the experts clarified that the reduction in emissions was modest.

[26]Several member states made limited use of benchmarking to develop part of their allocation plans. Benchmarking distributes allowances based on both a standard emissions rate, such as best available technology, and an economic indicator, such as the historical production levels for the covered entity.

[27]For example, see Ellerman, A. Denny and Barbara Buchner, "Over-Allocation or Abatement? A Preliminary Analysis of the EU ETS Based on the 2005-06 Emissions Data;" and Delarue, Erik D., A. Denny Ellerman, and William D. D'haeseleer, "Short-term CO2 Abatement in the European Power Sector," *Working Papers* (Cambridge, Mass.: MIT Center for Energy and Environmental Policy Research, June 2008). http://web.mit.edu/ceepr/www/publications/workingpapers.html (accessed Oct. 26, 2008)

Phase II of the ETS, which recently began and coincides with the commitment period under the Kyoto Protocol, relies on the same decentralized process to establish the emissions cap and allocation in phase I but differs in several ways. First, member states took verified emissions data from phase I into account to set emissions caps in phase II. According to our literature review and discussions with ETS stakeholders, the Commission took a stricter approach in approving the phase II National Allocation Plans and required member states to set more ambitious caps. Second, member states will continue to distribute most allowances for free in phase II but the amount of auctioning is expected to increase—about half of the EU member states plan to auction allowances in phase II.[28] Third, phase II differs from the first phase by allowing all covered entities to carry over, or bank, unused allowances to trading periods after phase II. The increased banking provisions in phase II may provide covered entities greater incentives to reduce carbon emissions. For example, banking provides an incentive for facilities to reduce emissions early, when costs are low, and save the allowances for a later time, when costs are high.

Looking ahead to phase III (2013 to 2020), the Commission has proposed legislation to amend the ETS by, for example, harmonizing the cap-setting and allocation process. Under the legislative proposal, the Directive would, according to the Commission, set a single, EU-wide emissions cap, which would amount to a 21 percent reduction in 2020 below 2005 verified emissions. The level of auctioning used to distribute allowances also would increase under the proposal. The Commission anticipates the legislation will be adopted in late 2008 or early 2009.

Phase I Economic Impacts Vary by Sector but Long-Term Effects Are Uncertain

The economic impacts of the ETS have varied among covered entities in the short term and are uncertain in the long term. Impacts of concern under the ETS have included leakage—the shifting of covered entities' economic activities to countries that have not adopted binding emission limits—and the competitiveness of covered entities, compliance costs, and price changes for consumer goods and services, such as electricity. While some energy-intensive industries covered under the ETS compete globally, our research shows that leakage was unlikely in phase I in part because

[28]During phase I, Hungary, Ireland, and Lithuania auctioned 4.18 percent, 1.81 percent, and 1.5 percent, respectively, of their total allowances. In addition, Denmark planned to auction 5 percent of its allowances but sold them on an exchange instead. See Fazekas, Dora, *Auction Design, Implementation and Results of the European Union Emissions Trading Scheme*, Columbia University, New York (2008).

covered entities received allowances for free and the cap exceeded actual emissions; when allowance prices are lower, leakage is less likely. Specifically, the emissions cap did not create a shortage of allowances that would have generated an allowance price high enough to encourage covered entities to relocate or move production to countries without limits on carbon dioxide emissions. One expert noted that it is too soon to judge the long-term economic impacts of the first phase.[29]

With respect to leakage, some researchers have assessed the likely extent of leakage to date and identified factors that contribute to the risk of leakage, such as global competitiveness, carbon intensity—the amount of carbon dioxide released per unit of output—and other factors. Available information shows that under the ETS, leakage is a greater risk among covered entities that rely on energy-intensive processes and have a limited ability to pass the allowance price to consumers due to international competition with entities not subject to carbon constraints. For example, a 2007 study based on energy and electricity data in the United Kingdom concluded that the potential for leakage is a valid concern for several sectors covered under the ETS, including cement, iron and steel, and pulp and paper.[30] Some ETS participants also have stated that auctioning allowances rather than freely allocating them would increase costs and therefore may increase leakage risk among globally competitive industries covered under the ETS.[31] According to some of the energy-intensive industries, their covered entities would not be able to pass allowance

[29]We asked experts to comment on the effects of phase I (2005 to 2007) because phase II has been underway for less than a year.

[30]Climate Strategies, *Differentiation and Dynamics of EU ETS Industrial Competitiveness Impacts* (Cambridge, United Kingdom, 2007).

[31]The basis for free allocation affects the risk of leakage. Consistent with economic theory, basing free allocation on historic levels of emissions would not reduce the risk of leakage whereas free allocation based on firm level changes—known as updating—may reduce the risk. Updating links free allocations to the firm's changing domestic level of emissions, energy use, or production. If historic levels of emissions are the basis for free allocation, a firm's free allocation is independent of level changes. In response to high domestic carbon prices, a firm could relocate its production to an area where carbon is not regulated without affecting its free allocation. However, if updating is the basis for free allocation, the firm is more likely to consider how its domestic emissions, energy use, or production will affect its free allocation. Updating increases the opportunity cost of leakage to the firm, as the basis for free allocation decreases when production is shifted abroad. Updating affects other emissions trading issues that are beyond the scope of this discussion.

prices to consumers while remaining competitive with entities outside the ETS that are not subject to carbon constraints.

Although researchers present consistent conclusions about the sectors most vulnerable to leakage, there is disagreement about the extent to which leakage would affect vulnerable sectors if allowance prices were to rise or if the number of allowances allocated freely were reduced. Beyond the uncertainty about future international carbon constraints, opinion regarding the extent to which ETS industries will be able to pass allowance prices to consumers varies. In addition, decisions about where to locate industrial production depend on factors outside of allowance prices, such as transportation costs.

Some ETS power producers, however, have already demonstrated an ability to pass allowance prices to consumers and benefited economically from free allocation under phase I. Studies have found that in the EU's deregulated energy markets, power producers passed on the market value of allowances to consumers by adding the value of the allowances to energy rates. Available information identifies a variety of factors that contributed to energy rate increases, though, making it difficult to determine the extent to which higher prices resulted from the ETS. According to available information, additional reasons for energy price increases include ongoing deregulation of the EU electricity markets, weather conditions—which affect supply and demand for energy—and fossil fuel prices.[32] Nonetheless, to the extent that power producers in deregulated markets added the value of allowances—which they received for free—to the rates that they charged consumers, the first ETS phase resulted in windfall profits for this sector while contributing to increased costs for some energy consumers.[33]

[32]The EU's transition from a regulated electricity market to a "liberalized" or deregulated electricity market in which electricity generators compete to meet the demands of residential, commercial, and industrial consumers, coincided with the first phase. The ability for generators to pass the cost of allowances to consumers depended in part on the progress their member state had made toward deregulation. Some member states had deregulated the electricity markets by the time the first ETS phase was under way, such as the United Kingdom and the Netherlands, whereas others, including Poland and Spain, had not.

[33]Some industrial consumers had long-term electricity contracts, which would have fixed their electricity rates during the first phase.

Despite the potential economic impacts of a system to limit carbon dioxide emissions, the first ETS phase included several features that covered entities could use to limit compliance costs. For example, phase I included the use of international offsets in the form of CDM credits, discussed in the next section of this report, as a cost containment feature.[34] Offsets can reduce the costs of compliance by allowing facilities to pay for abatement in areas where it may be cheaper to do so and apply the credits toward their own caps. Another feature intended to reduce costs allowed covered entities to bank allowances from one year to another within the first phase. In theory, banking provides an incentive for facilities to reduce emissions early, when costs are low, and save the allowances for a later time, when costs are high. According to available information, banking provided limited abatement incentives in practice, however, because covered entities generally were not allowed to carry allowances from phase I to phase II. As a result, very few covered entities could minimize costs in phase II by using allowances from phase I.

The Commission has since proposed legislation to modify allocation methods and cost containment features for the third trading phase and beyond. First, the Commission's proposal would allow full banking of unused allowances from the second phase while restricting the use of CDM offset credits starting in 2013 if no future international climate change agreement has entered into force. Second, the Commission's proposal would end free allowance allocation to the power industry in 2013. According to the Commission, requiring the power industry to purchase allowances through an auction and market trading would eliminate windfall profits in this industry and provide an incentive for less-carbon-intensive power generation. The Commission also has proposed to gradually phase out free allocation and increase auctioning to other entities covered under the ETS but will evaluate the potential risks of leakage associated with such an approach.

[34]A limited number of carbon offset credits generated from certain CDM projects could be used to meet caps under the ETS.

The Effect of ETS Phase I on Technology Development and Innovation Are Uncertain but Likely Minimal

It is too soon to know whether the first phase had an impact on long-term technology development and innovation, and researchers conclude that the impact, if any, is likely minimal. According to the IPCC, technology research and development are essential to the development of a less-carbon-intensive energy infrastructure required to reduce emissions in the long term.[35] A senior official at the Council on Environmental Quality told us that emissions trading can be a cost-effective tool to achieve long-term reduction goals but that in some cases it may not provide incentives for technology investment. Several EU industry representatives told us that covered entities have begun to consider the ETS and associated costs when making business decisions but this has not resulted in widespread technology changes. Available information suggests that regulatory uncertainty, low carbon prices, and program design features likely dampened incentives in the first phase to invest in clean technologies.

First, the uncertainty about future emissions caps—and thus the extent of abatement required at covered entities—and restrictions on banking limited the incentive to invest in technology in advance of the first phase. Specifically, the duration of phase I was not compatible with investment decision timelines. According to a European power industry official, it may take 5 to 10 years for technology investments to come to fruition, a longer time frame than the first phase's 3-year trading period. The general inability to bank unused allowances to the second trading phase (2008 to 2012) also limited abatement incentives in phase I. The allowances expired at the end of phase I and thereby provided an incentive to emit rather than reduce carbon dioxide emissions and save the allowances for another time.

Second, the expected reduction goals for phase I were modest and, according to some market analysts, allowance prices have not been high enough to influence technology investment decisions, such as development of carbon capture and storage. Identified by the IPCC as a key potential abatement technology, carbon capture and storage involves capturing carbon dioxide from a power plant's emissions, transporting it to an underground storage location, and then injecting it into a geologic formation for long-term storage. While other options exist to reduce emissions—such as energy efficiency improvements, a switch to less-

[35] The IPCC refers to investment in technology research, development, demonstration, deployment and diffusion, and induced technology change to stabilize greenhouse gas concentrations at a level that would prevent dangerous anthropogenic interference with the climate system.

carbon-intensive fuels, nuclear power, and renewable energy sources—carbon capture and storage is considered by many an essential technology because it has the potential to greatly reduce emissions from power plants while allowing for projected increases in electricity demand.[36] One consulting firm has estimated that demonstration projects to test carbon capture and storage in the EU between 2012 and 2015 would cost €60 to €90 per metric ton of carbon dioxide abated, well above the phase I allowance price.[37]

Third, available information also suggests that the rules governing allowances for new entrants—covered entities that did not begin operation until after a member state's submission of a National Allocation Plan—limited incentives to invest in low-carbon technologies. The ETS Directive required member states to ensure new entrants had access to allowances but did not specify how they should do so.[38] In practice, all of the member states distributed allowances to new entrants for free. Researchers believe that free allocation to new entrants reduces the investment costs of carbon-intensive technologies, such as coal-fired power plants, compared to low-carbon technologies or renewable energy, and effectively eliminates the incentive for investment in low-carbon technologies.

The allocation rules for covered entities that closed during the first phase also affected investment incentives. Available information indicates that most of the member states required closing plants to give back the allowances rather than sell them on the market, thereby providing an incentive for these facilities to continue operating. Covered entities that would have closed in the absence of the ETS may have continued operating in order to keep the allowances.

Finally, the Commission has sought to provide greater certainty about emission caps for future trading phases. The EU has committed to continue emissions trading and aims to finalize by late 2008 or early 2009

[36]For more on carbon capture and storage, see GAO, *Climate Change: Federal Actions Will Greatly Affect the Viability of Carbon Capture and Storage as a Key Mitigation Option* (Washington, D.C.: Sept. 30, 2008).

[37]Estimates are adjusted for predicted inflation and based on installations at new facilities; costs to retrofit existing plants expected to be higher. See McKinsey & Company, *Carbon Capture & Storage: Assessing the Economics* (2008).

[38]ETS Directive, 2003/87/EC, art. 11(3), Oct. 13, 2003.

the Commission's proposed legislation that would modify the trading phases after 2012. Among other things, the proposal aims to reduce greenhouse gases by at least 20 percent by 2020.

ETS Phase I Experience Offers Key Lessons about Program Design and Implementation

Available information and experts revealed lessons about three key aspects of phase I, including the importance of baseline data, program design and implementation, and related economic effects. In particular, experts discussed how these lessons might inform the design of U.S. climate change policies.

Baseline Data

First, available information indicated that accurate baseline data are essential to setting an effective emissions cap and achieving the intended environmental objectives. The accuracy and availability of baseline data at the covered entity, sector, and national level also influence the effectiveness of the emissions cap.

Availability of data. About half of the experts said that emissions data should be in place before starting an emissions trading program. Many experts commented, however, that they would not expect the United States to encounter the data challenges experienced in the first phase because certain data are already available and several noted that existing data about U.S. emissions are sufficient to establish an emissions trading program. Specifically, they stated that the United States has good data on fossil fuel consumption that can be used to estimate economy-wide carbon dioxide emissions as well as facility-specific data on carbon dioxide emissions from power plants that have participated in the Clean Air Act's sulfur dioxide emissions trading program. Moreover, our literature review indicates that the availability of historical baseline data would reduce the incentive for covered entities to inflate baseline emissions prior to the establishment of a program to obtain a greater allocation. Nonetheless, a few experts said that emissions data in the United States could be improved. For example, one expert noted that emissions of greenhouse gases other than carbon dioxide are more uncertain.

Specificity of data. The required accuracy of data at the covered entity, sector, and national level depends on, and must therefore be compatible with, the program's point of regulation. The point of regulation may occur (1) "upstream" and cover sources of carbon dioxide when they first enter the economy, such as fossil fuel producers; (2) "downstream" and cover direct and indirect emitters, such as power plants; or (3) at a combination of upstream and downstream sources. A downstream program like the ETS requires facility-specific data in order to determine how many allowances to distribute to individual entities. In contrast, programs that incorporate upstream sources, such as the one proposed in the Lieberman-Warner Climate Security Act of 2008,[39] primarily rely on economy-wide data, which may be more readily available than facility-specific data. Several experts stated that an upstream program would simplify data requirements and avoid the phase I challenge to obtain the facility-specific baseline data. Available information also identifies the simplified data requirements of an upstream program as an advantage but notes that such programs demand greater cooperation and political support than downstream programs.

Program Design Features

The second group of key lessons relates to how program design features may influence the effectiveness of emissions trading and includes the following features: the emissions cap, program scope, allocation method, measures to limit risk of leakage, program timeline, and linking to other programs. As noted by several experts, some implementation challenges, such as data limitations or lobbying pressure to inflate the cap for a particular industry sector, are inevitable but steps can be taken to minimize their consequences. In addition, nearly all of the experts discussed ways that design features can maximize incentives to cost-effectively reduce emissions.

Emissions cap. Experts identified design features that would provide incentives to reduce emissions even if the cap initially exceeds emissions. For example, several experts recommended establishing a long-term, declining emissions cap, which would ensure gradual emissions scarcity in the program. A few experts also pointed out that allowing full banking with a long-term declining cap would provide an incentive to reduce emissions earlier.

Program scope. The scope of the program, specifically the extent to which it regulates all greenhouse gas emissions in the economy, influences the cost-effectiveness of reductions. In theory, opportunities for cost-effective reductions will increase as the number of sources included in the program increases but in practice there may be limits to enhancing cost-effectiveness with expanding scope. Many of the experts stated that a U.S. program should include as many sources of carbon dioxide emissions as possible; several also stated that it should cover all six greenhouse gases. Several experts noted, however, that emissions trading may not be the

[39] S. 3036, 110th Congress (2008).

most effective way to control all greenhouse gas emissions. One expert clarified that while the scope of a trading program should be “as wide as possible,” it should only include emissions that “can be credibly monitored, reported, and verified.” Similarly, the European Commission told us that the ETS began with a narrow scope, regulating approximately half of the EU’s carbon dioxide emissions, because of feasibility concerns and plans to expand to other gases and sectors in the future. Another expert echoed the idea of targeted expansion in noting that forestry and agriculture sources should be only gradually involved in a trading program because of uncertainties in measuring emissions. Furthermore, one expert suggested alternative forms of regulation, such as emission standards, to limit the non-carbon-dioxide greenhouse gases that may not be effectively monitored or enforced under emissions trading.

Allocation method. According to available information, the way a program distributes allowances also impacts the program’s total cost and the distribution of cost burden among stakeholders. An auction, for instance, may impose costs on particular sectors covered under the program but generate revenues that may be used to offset the cost of the emissions trading program on consumers or covered sectors through reinvestment in other programs, which may or may not relate to climate change. Some of the experts who discussed the benefits of auctioning provided examples of ways to use auction revenues, such as research and development of clean energy technologies, to lower income taxes, to lower business taxes, to expand earned income tax credits, or for energy efficiency programs. In addition, one expert noted that greater use of auctioning also may minimize the perverse incentives favoring processes that are more-carbon-intensive under the ETS rules for closure and new entrants. Accordingly, many of the experts stated that a trading program should maximize the level of auctioning.

Free allocation to emitters, on the other hand, may reduce costs for sectors covered under the trading program but not for consumers. Although the ability of covered entities to pass costs to consumers in the form of higher product prices varies, available information reveals that free allocation does not prevent increases in consumer product prices resulting from the emissions program. The first phase shows that covered entities may still pass costs through to consumers.

Risk of leakage. The experts also provided insights about potential for leakage to affect covered sectors. Most of the experts said that leakage would pose a risk under a U.S. emissions trading program, although views on the degree of risk varied. Some of the experts clarified that it would pose a significant risk for certain industries, in particular energy-intensive industries that compete with facilities in countries without binding carbon caps. The option most frequently identified to prevent leakage was securing global participation in international climate agreements.

The experts discussed alternative options to reduce the risk of leakage in the absence of a global agreement, including some form of targeted free allowance allocation, cost containment mechanisms, and trade measures. The alternatives involve a set of tradeoffs and as one expert noted, require detailed information about “which sectors or subsectors would experience leakage.” For example, free allocation may reduce compliance costs for globally competitive entities but as another expert noted, may deter investment in less-carbon-intensive technologies. Moreover, one expert pointed out that entities may sell the allowances and relocate anyway. Some of the experts stated that cost containment mechanisms, such as allowing the use of offsets, could reduce the cost impact on covered entities by lowering the allowance price. The lower allowance price in turn is expected to reduce the risk of leakage. Many of the experts suggested trade measures to level the playing field for globally competitive, carbon-intensive entities. Trade measures identified included either a border tax or an allowance requirement for goods imported from entities not subject to carbon constraints. However, a few experts discussed drawbacks, such as difficulty in identifying which sectors are vulnerable to global competition and the possibility of retaliatory trade measures. In addition, opinions vary as to whether these trade measures would be permitted under World Trade Organization rules.

Program timeline. Many of the experts viewed the program timelines as an important feature to reduce uncertainty that deters investment in less-carbon-intensive technologies, while several also emphasized cost certainty as a key feature. The experts commenting on timelines stated that a trading program should cover a long enough time period to influence technology investment decisions. A few experts noted that the risk of subsequent changes to specified targets—because of developing scientific opinion or changes in political commitments—makes it important also to provide certainty about costs to incentivize technology development. For example, specifying a minimum auction price for allowances would increase certainty about the long-term value of investments to reduce emissions.

Linking. Finally, the experts presented a wide range of opinions regarding the extent to which a program benefits from linking to other trading programs. Linking occurs when covered entities in one program can use the allowances from another trading program for compliance and, sometimes, vice versa.[40] For example, linking the EU ETS to a U.S. trading program could allow covered entities in the United States to purchase EUAs and use them to cover emissions. In theory, linking can enhance the cost-effectiveness of the participating programs by enabling covered entities to take advantage of differences in the costs of abatement options. According to available information and experts, the design features of the program also will carry through to the linked program. As a result, it may be difficult and less cost-effective to link programs in practice. Many of the experts discussed the complications resulting from linking programs with different cost containment measures, in particular a safety valve. Safety valves are mechanisms, such as maximum allowance price, that trigger cost containment actions. For example, one kind of safety valve might allow the government to sell additional carbon allowances if the market price for allowances exceeded a predetermined amount—the increased supply may lower the market price but also would increase the emissions cap. Linking a program with a safety valve to another program without one would carry the safety valve through to the latter program. About one-third of experts concluded that linking programs with different cost containment measures may compromise the environmental integrity of the programs.

Wealth Transfer

The third and final category of lessons relates to wealth transfer, as the ETS demonstrated that giving away allowances can create and transfer substantial assets of considerable value. The distribution of wealth creates a strong incentive for regulated entities to influence the design and implementation of a trading program. Five experts clarified that while lobbying pressure from stakeholders is inevitable, steps should be taken to minimize the effects. Along those lines, some of the experts stated that auctioning allowances would minimize the adverse impact of lobbying activity—that is, it would reduce pressure to increase individual allocations that may compromise the emissions cap. Another expert noted that the inevitable lobbying activity warrants having decision makers set the cap in federal legislation to ensure greater accountability. Finally, available information also indicates that while there may be advantages to starting with a small program and expanding it, modifying emissions trading programs can introduce technical and political challenges. As an

[40]Linking also may be one-way—participants in program A could use allowances from program B, but not vice versa. Linking also may be indirect—participants in programs A and B could use allowances from a third program, C, but not from each other.

official at an international research organization observed, it is difficult to change who gains and who loses under a trading program after it has been established.

The CDM's Environmental and Economic Effects Provide Important Lessons That Can Inform Congressional Deliberations on Climate Change Policy

According to available information and experts, the CDM has enabled industrialized countries to make progress toward achieving their emissions targets at less cost and has involved developing countries in these efforts; however, the program's effect on emissions is uncertain, and its impact on sustainable development has been limited. Further, we found that the CDM's approval process significantly limits the scale and cost-effectiveness of emission reductions achieved through the program, although several proposed reforms may help to streamline this process. Nonetheless, the international experience with the CDM has provided key lessons that may help inform congressional decision making.

The CDM Has Enabled Covered Entities to Pursue Lower-Cost Reductions and Involved Developing Countries in the Global Carbon Market

Beginning operation in 2002, the CDM can allow countries to make progress toward their emissions targets under the Kyoto Protocol at less cost through the use of carbon offset credits. This includes not only countries under the EU ETS, but all countries that have ratified the Protocol and meet certain requirements. However, while countries outside the scope of the ETS—specifically, Canada, New Zealand, Switzerland, and Japan—have invested in CDM projects, demand has been driven primarily by covered entities in the EU, which can count CDM credits toward their emissions caps under the ETS. For many of these entities, investing in CERs can provide a lower-cost alternative to reducing emissions on-site or purchasing EUAs. Further, the availability of CERs may produce lower allowance prices than would be observed under a no-offset scenario. As a result, the CDM can potentially reduce firms' compliance costs regardless of whether these firms choose to purchase CERs.

While both EUAs and CERs can be used for the same purposes in the ETS, investors in the CDM market face higher risks, depending on the type of

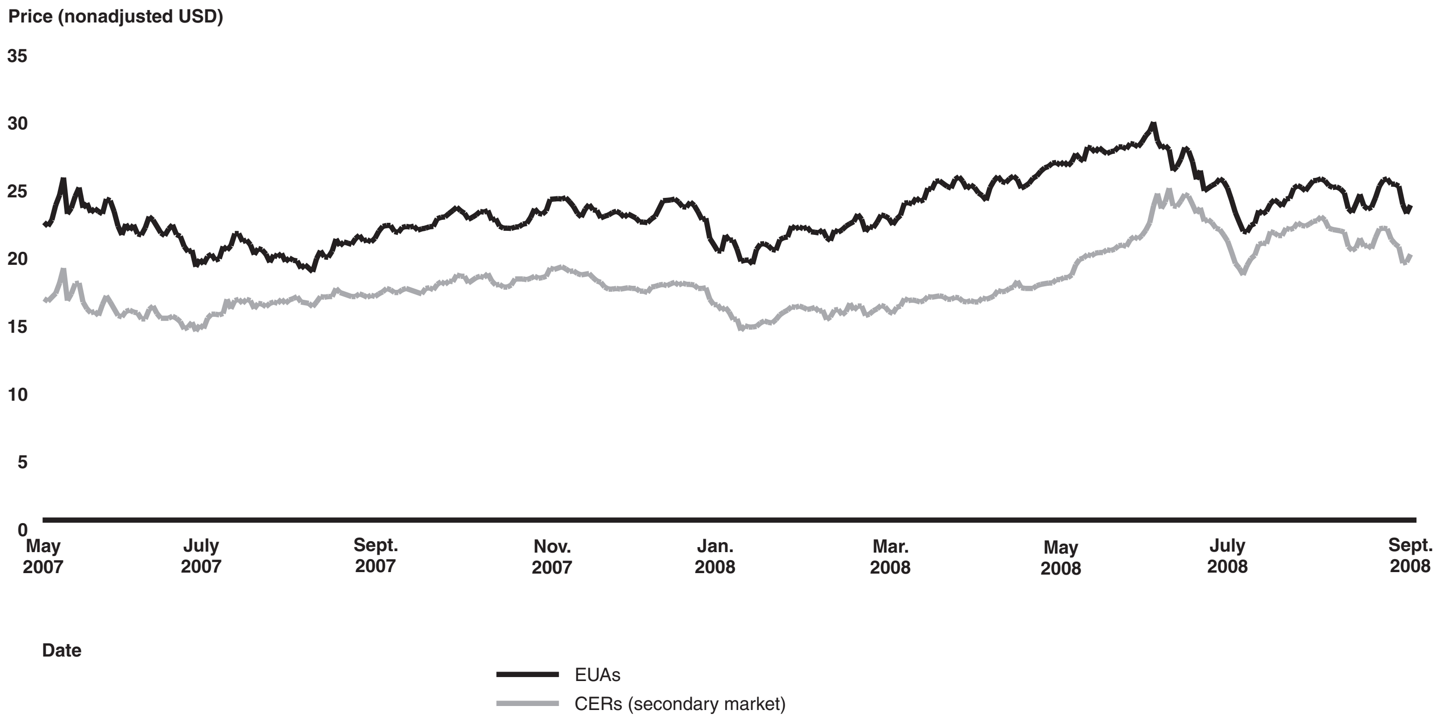
CER purchased.[41] "Primary CERs" involve a higher level of uncertainty because most purchases involve forward contracts—the buyer purchases the rights to future credits instead of the credits themselves. Because primary CERs are not issued until the project is completed and emissions are verified, there is some risk that the project will not produce the expected number of CERs. For example, the CDM's Executive Board may delay or reject a project and even approved projects might not be built on schedule or within budget. Further, the amount of actual reductions may differ from what was planned—for example, wind projects may generate more or less electricity depending on weather conditions. One study shows that projects reaching the registration phase tended to yield only about 76 percent of their forecasted CERs.[42] In order to reduce market risks, an increasing number of CDM participants purchase "secondary" CERs, which are offered with a guarantee of delivery. These secondary CERs, represented in figure 3, carry less risk and are more expensive than primary CERs, although they still sell at a discount to EUAs.[43]

[41]Most CERs can be used for compliance in Europe, with one CER being equal to one EUA. However, certain types of CERs are not eligible for ETS compliance, including nuclear and forestry projects and, under certain conditions, large-scale hydropower projects.

[42]Castro, Paula and Michaelowa, Axel. *Empirical Analysis of Performance of CDM Projects.* Climate Strategies, Zurich, Switzerland (2008).

[43]According to one expert, the current price difference between EUA allowances and secondary CERs is primarily due to the limit on imported CERs in the ETS.

Figure 3: Price Differential between CERs and EUAs



Source: Point Carbon (2008).

Despite uncertainties about the delivery of CERs, the CDM market has grown at a considerable rate over the past few years, mobilizing private and public sectors in both industrialized and developing countries to invest billions of dollars in projects designed to decrease greenhouse gas emissions. CDM transactions amounted to nearly $13 billion in 2007, an increase of over 200 percent from 2006.[44] On a global scale, the introduction of CDM credits as a commodity has encouraged businesses and entrepreneurs to seek out emission reduction opportunities in developing countries and has spurred the creation of consulting firms that help steer participants through the approval process.

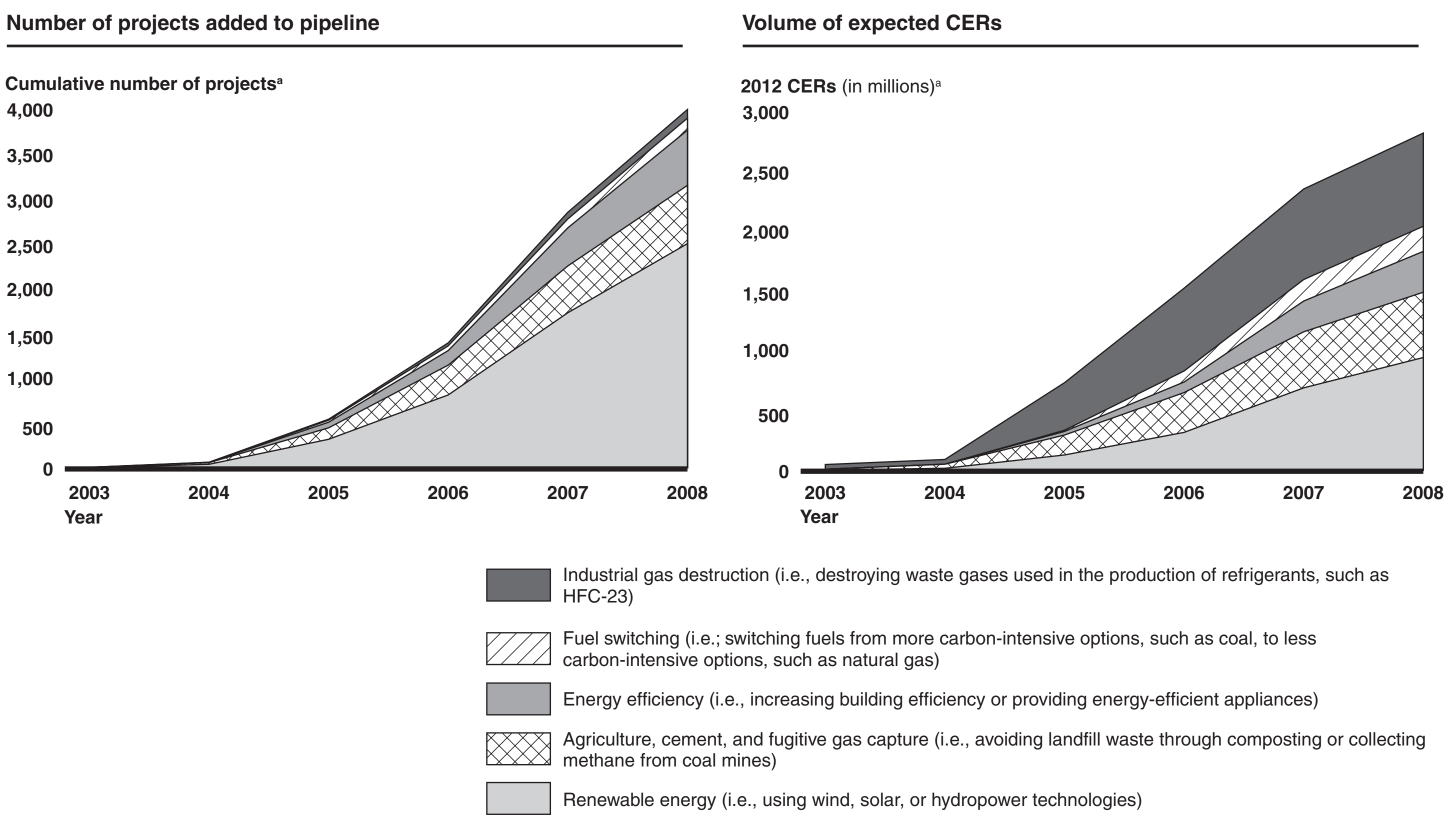
For developing countries that do not have emissions targets under the Kyoto Protocol, the demand for CERs has provided an economic incentive to pursue emission reduction activities. As of October 2008, over 3,800 different projects were seeking credits through the CDM. Of these, over

[44]The World Bank, *State and Trends of the Carbon Market,* Washington, D.C., 2008.

1,100 have already officially registered through the CDM's Executive Board, and nearly 400 have received CERs. The first chart in figure 4 shows the most common types of projects and their growth over time, while the second chart shows the volume of credits expected to be produced through 2012. Because some CDM projects destroy gases more potent than carbon dioxide—in particular, industrial gases—these projects are an abundant source of credits and, as the second chart in figure 4 shows, represent a larger share of overall expected reductions than the number of projects might suggest.[45]

[45]Under the Kyoto Protocol, carbon offsets are quantified and described in terms of carbon dioxide equivalent. Carbon dioxide equivalents provide a common standard for measuring the warming efficiency of different greenhouse gases and are calculated by multiplying the emissions of the non-carbon-dioxide gas by its global warming potential, a factor that measures its heat-trapping ability relative to that of carbon dioxide.

Figure 4: CDM Pipeline



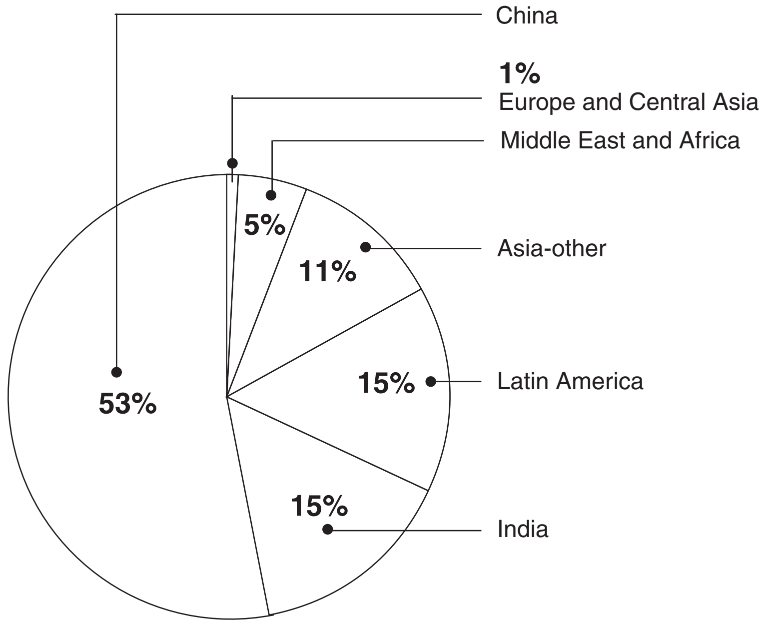
Source: GAO analysis of UNEP Risoe Center data (2008).

Note: Forestry projects make up less than 1 percent and are excluded.

[a]Expected number of CERs to be issued through 2012.

While CDM projects have been established in over 70 developing countries, most benefits have thus far accrued to fast-growing nations such as China and India. In fact, these two countries host over half of all registered projects. Conversely, countries in Africa and the Middle East have seen little CDM-related investment. For example, only 10 CDM projects have been registered in what the UN defines as “least developed countries.” Figure 5 illustrates the distribution of emission reductions by geographic region.

Figure 5: Distribution of CERs by Host Country



Source: GAO analysis of UNEP Risoe Center data (2008).

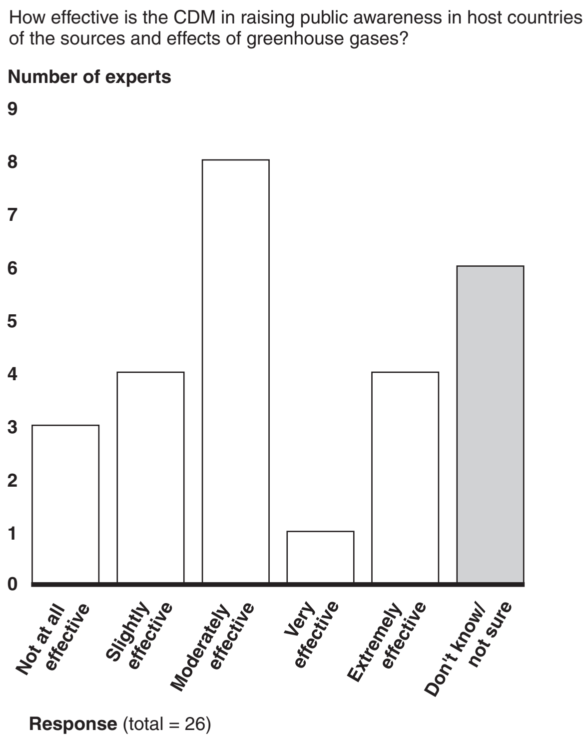
Several factors explain the relative concentration of projects. First, the relatively large economies in China and India provide a higher number of emission reduction opportunities. In addition, these countries have developed an institutional capacity that can accommodate a large and fast-moving flow of projects. Host country governments, banks, and private sector firms have become familiar with emissions trading and the CDM, in part because of the financial transfers it facilitates.

While some observers have criticized the unequal distribution of projects, it also is true that China and India are expected to represent a significant source of future emissions, and the CDM could enhance these countries' interest in future international dialogue over climate change policy. Many experts said that the CDM has helped to engage developing nations and create political buy-in for further actions to reduce the global concentration of greenhouse gases; in fact, two experts stated that this was the CDM's primary benefit. Another noted simply that the CDM represents one of the only incentives for developing countries to undertake emission reduction activities.

On the other hand, less-developed countries may lack the capacity to implement CDM activities and navigate the complexities of the process. Potential investors in CDM projects also may be deterred from projects in certain countries due to an unfavorable investment environment, lack of a legal framework, insufficient access to finance, or political instability. However, evidence suggests that certain developing nations are gaining experience with the CDM, and several programs have been created to help expand participation in the future. For example, the UN created the Nairobi Framework in 2006, an initiative aimed at building CDM capacity in lesser developed nations.

The CDM also may boost public awareness of climate change in host countries. For example, CDM participants in India told us that the program has increased overall public knowledge of climate change issues, although it appears that specific interest in CDM has largely been concentrated within industry and market circles. Some experts we consulted agreed with this perspective—a fourth of those who rated the CDM's effectiveness characterized it as an "extremely" or "very" effective tool to raise awareness about greenhouse gases, as shown in figure 6.

Figure 6: Summary of Responses from Expert Panel: Effects of CDM on Public Awareness



Source: Consolidated responses from experts.

On the other hand, using the CDM to involve developing nations in efforts to address climate change may not always have positive effects. For example, some experts said the mechanism encourages host countries to rely on external funding from industrialized nations. Others went further, saying the CDM can dampen or delay efforts by host countries to reduce emissions on their own. The CDM does not credit emission reductions that result from newly imposed policies or standards, in part because it would be difficult to demonstrate that emission reductions were a direct result of the law. This may pose a dilemma for host countries that want to implement low-carbon policies but also want to attract investment through the CDM. Given these considerations, many experts and researchers have said the CDM would best be used as a temporary tool to help transition countries toward broader commitments.

Despite Rigorous Review Process, the Net Effect of the CDM on Emissions Is Unclear

The overall effect of the CDM on international emissions is uncertain, largely because it is nearly impossible to determine the level of emissions that would have occurred in the absence of each project. This concept of additionality is fundamental to the credibility of the CDM because only projects that are additional will lower emissions beyond what would have occurred without the program.[46] Accordingly, the parties to the protocol have implemented a rigorous project approval process with an extensive set of requirements to ensure that credits received through the CDM represent real and additional emission reductions.[47] However, because additionality is based on projections of what would have occurred in the absence of the CDM, which are necessarily hypothetical, it is impossible to know with certainty whether any given project is additional.

As part of this process, project applicants must demonstrate the additionality of the proposed project and estimate the emission reductions that will occur as a result of the project's implementation. In practice, this means that applicants must show that the project would not have occurred without the CDM, due to technological, economic, or other barriers. They must then estimate the reductions achieved by the project using a projected business-as-usual baseline. Documentation for the project must be evaluated by an independent auditing firm, approved by the host country, and then formally accepted by the CDM Executive Board on a case-by-case basis. Once approved, emissions from each project are monitored periodically in accordance with procedures outlined in the initial project proposal. Credits are issued only for emission reductions that have been verified by a separate, independent auditing firm.[48]

This process may increase the likelihood that projects are additional, and evidence indicates that the CDM's screening process has become more

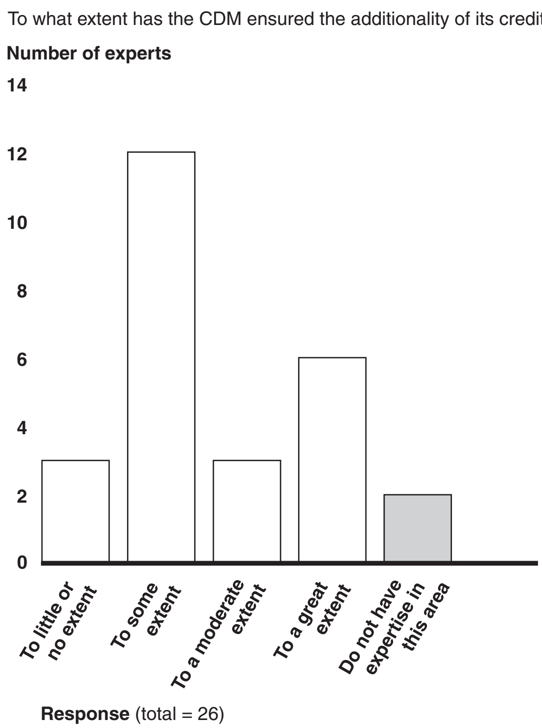
[46]As we reported in August 2008, additionality is fundamental to the credibility of offsets because only offsets that are additional to business-as-usual activities result in new environmental benefits. See GAO, *Carbon Offsets: The U.S. Voluntary Market Is Growing, but Quality Assurance Poses Challenges for Market Participants*, GAO-08-1048 (Washington, D.C.: Aug. 29, 2008).

[47]The approval process for large-scale CDM projects is composed of validation, registration, verification, and certification. Please see fig. 8 for an explanation of the process. A separate and simplified process exists for small-scale CDM projects.

[48]The Marrakech Accords state that these auditors, called Designated Operational Entities, should perform either (1) validation or (2) verification and certification for any given CDM project activity; however, upon request to the Executive Board, it is possible that a single Designated Operational Entity could perform all the functions.

stringent over time. Many stakeholders we interviewed said that the majority of projects under CDM are additional and would not have been undertaken without the opportunity to earn carbon credits. Further, a majority of experts we consulted agreed that the CDM's approval process ensures a higher degree of project quality, on average, than in voluntary offsets markets, though some suggested that voluntary market standards represented a fairly low benchmark for quality.[49] Figure 7 summarizes our experts' responses.

Figure 7: Additionality in the CDM



Source: Consolidated responses from experts.

However, significant challenges to ensuring credit quality exist. Many experts and stakeholders have suggested that a substantial number of nonadditional projects have received credits through the CDM, a conclusion supported by several studies. Further, while CDM participants we interviewed in India and China did not explicitly criticize the CDM's

[49]For further information on the voluntary carbon offset market, see GAO-08-1048.

screening process, their comments often ran counter to the concept of additionality. For example, several representatives from the cement and auto industries said they would pursue clean energy projects regardless of the CDM, describing the CDM credits as more of a “bonus” than a driver of investment. In response to concerns about the quality of projects under the program, the CDM’s Executive Board has taken steps to improve the process, such as adding staff, creating a manual for verifiers, and increasing project reviews and rejections. However, the Executive Board may find it increasingly difficult to evaluate additionality, according to two of our experts, as host countries begin to factor the CDM into their planning efforts and it becomes more difficult to identify what would have happened without the program.

The presence of nonadditional projects can diminish or negate the environmental benefits of the CDM. Because the CDM is primarily used by countries to comply with the Kyoto Protocol’s binding targets and the ETS’s emissions caps, credits that do not represent real and additional emission reductions do not represent progress toward these targets or caps. This is particularly important in the context of cap-and-trade programs that use the CDM for compliance, such as the ETS, because nonadditional projects can compromise the environmental integrity of the emissions cap. If a significant number of nonadditional credits are allowed into the program, for instance, these credits may allow covered entities to increase their emissions without a corresponding reduction in a developing country. This can cause emissions levels to rise above the targets set by the program, introducing uncertainty as to the actual level of reductions, if any, achieved by the program. The extent of this effect is difficult to estimate; it depends on the number of nonadditional credits and the extent to which offset credits can be used in the compliance program, among other things.[50] Because of the challenges of ensuring additionality under the CDM, several experts said the CDM has had a negligible or negative environmental effect. According to one expert, maintaining anything less than “a great extent” of additionality is unacceptable, because the result is a higher level of worldwide emissions than would have occurred in the absence of the CDM.

[50]For further analysis on the potential effects of linking offset programs to mandatory emission reduction schemes, see: Stavins, Robert N. and Judson Jaffe. *Linking Tradable Permit Systems for Greenhouse Gas Emissions: Opportunities, Implications, and Challenges*. IETA Report on Linking GHG Emissions Trading Systems. Geneva, Switzerland, November 2007.

In the current phase II of the ETS, the number of CDM credits that can be used to meet emissions caps is limited. As we have previously reported, limits on the use of offset credits in mandatory emission reduction programs involve tradeoffs.[51] On the one hand, such limits may increase compliance costs. On the other hand, they can help provide incentives for technology research and promote fundamental changes within industries bound by the program. Limits on offsets can also help confine the negative impact of nonadditional offset credits in the event that additionality controls fail.

In order to fully realize these benefits, however, limits on offsets must be sufficiently stringent. For phase II of the ETS, the European Commission established fairly generous limits—member states are able to use CDM credits for about 12 percent of their emissions cap, on average.[52] Researchers have since concluded that these limits could allow member states to achieve the majority of emission reductions through offsets and reduce little in the EU. This is partly because the limits were based upon the total emissions cap rather than the "distance to target"—that is, the gap between the current emissions level and the cap. According to one European Commission official, the ETS legislative proposal will address this concern, as it prevents new CDM credits—with some exceptions—from entering the ETS during the third phase of the scheme.[53] A committee of the European Parliament also has proposed stricter limits on both the quantity and quality of credits in the third phase. However, at least one study disputes whether these changes will be sufficient to ensure that the EU's long-term reduction targets are met.[54]

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[51]GAO-08-1048.

[52]Limits for the use of offsets vary by country, with a range from 0 percent to 20 percent of a country's total cap, and an average limit of 11.6 percent. These limits, which apply to the current phase II of the EU ETS, were approved by the European Commission based on the Kyoto Protocol's principle of supplementarity, which directs industrialized countries to use the CDM program only as a supplement to their own domestic emission reduction efforts.

[53]The Commission's legislative proposal restricts use of CDM credits in phase III of the ETS in the absence of a post-Kyoto international agreement on emission reductions. If there is no such agreement, the use of CERs would be restricted to the amount of the unused CERs that member states' phase II National Allocation Plans permit. If there is an agreement, CERs from its signatories can be used to satisfy up to half of the ETS cap.

[54]Höhne,Niklas and Ellerman, Christian. *The EU's emission reduction target, intended use of CDM and its +2°C.* Ecofys, Köln, Germany (2008).

It is important to note that while nonadditional projects do not represent a net decrease in emissions, this does not preclude them from conferring environmental benefits. For example, a wind power project may be profitable without the CDM but can be valuable from an environmental and public health perspective. Further, a few experts pointed out that permitting offset programs like the CDM in emissions trading programs may allow the negotiation of more stringent emissions caps, since offsets can reduce the overall cost of compliance programs. This effect may help balance out the effects of nonadditional projects.

The CDM's Contributions to Sustainable Development Have Been Limited

Although the Protocol does not define sustainable development, in other contexts the UN has described it as a strategy that "meets the needs of the present without compromising the ability of future generations to meet their own needs," and can encompass environmental, economic, and political sustainability. The CDM's rules require that each emissions reduction project assist a host country in achieving sustainable development, but does not provide overarching standards with which to assess these projects. Instead, it delegates responsibility to host countries, each of which defines its own sustainable development criteria that it can use to approve or reject CDM projects. Projects could presumably fulfill this requirement in a variety of ways; for example, by promoting sustainable agriculture or by introducing renewable technologies to fulfill energy demand.

Overall, most evidence indicates that the CDM has had a limited effect on sustainable development. For example, multiple stakeholders we spoke with said the CDM has not had a significant impact in this area, although one researcher acknowledged that such outcomes may be difficult to assess in the short term. Stakeholders in India, many of whom stood to benefit financially from the CDM, spoke more positively of the CDM's contributions to sustainable development, mentioning wide-ranging benefits such as job creation, improved air quality, and enhanced energy supply in rural areas.

The CDM's limited effect could be due, in part, to its market-based structure. Developing countries may have few incentives to enact stringent criteria for sustainable development since they are effectively competing for CDM projects, and stringent standards may raise the cost of developing a project and deter potential investors. In India, for example, projects are approved by the national CDM authority based on whether they align with the country's pre-existing sustainability guidelines.[55] However, CDM participants we spoke with in India said it was relatively easy to get a project approved; on the day we visited, for example, 25 projects had been reviewed and approved. In addition, because the CDM encourages investors to seek out the lowest-cost reductions, projects that make considerable contributions to sustainable development may be at a disadvantage. Some of the most attractive projects to investors, in terms of CERs produced, have a relatively small impact on sustainable development, and the CDM does not provide financial rewards for projects that exceed minimum sustainable development standards.

Although the CDM does not claim technology transfer as an explicit objective, most consider the introduction and diffusion of new technologies in project host countries to be an important outcome. Given available information, however, the effect of the CDM in this area has thus far been modest. According to CDM participants we spoke with in India, most projects have used technologies that were already commercially available within the country, although some said the CDM has helped mitigate the risk of investing in new technologies. The experts had a similar view—of those who provided an opinion, about two-thirds said the CDM was "not effective" or "slightly effective" as a tool for technology transfer. On the other hand, slightly over a third believed the CDM was "moderately" or "very" effective.

Some studies have attempted to quantify the extent of technology transfer under the CDM. According to a review of available research, between one-third and one-half of CDM projects involve some type of technology transfer. Such transfer is much more common in certain types of projects, such as industrial gas projects that utilize "end-of-pipe" technologies developed in Europe and Japan. Apart from industrial gas destruction, the project types most likely to involve technology transfer appear to be wind power, landfill gas capture, and agriculture (biogas). However, one expert pointed out that most of the wind power capacity represented in the CDM project pipeline is sited in India and China, countries that have supported domestic wind industries prior to the CDM. This suggests that while the CDM may provide a boost to these industries, it is not creating a new wind industry in either country.

[55] National CDM authorities in host countries must approve proposed CDM projects before they can be submitted to the CDM Executive Board for formal acceptance.

Industrial gas projects have been a controversial source of credits, particularly those involving the waste gas HFC-23. HFC-23 is produced during the manufacture of another gas, HCFC-22, which is used in some air conditioners and in the production of certain plastics. Industrial gases are several thousand times more potent than carbon dioxide, in terms of warming potential, and thus yield large quantities of credits. For example, while these projects account for only 1 percent of projects in the pipeline, they represent 18 percent of all expected credits through 2012. However, given that industrial gas projects involve simple, end-of-pipe technologies, they do little to promote efficient energy use or contribute to long-term sustainable development objectives.

In addition, some researchers have argued that the CDM is an inefficient way to reduce industrial gas emissions. For example, one study estimates that HFC-23 reductions cost project developers less than $1 per ton of carbon dioxide equivalent, whereas CERs have historically been sold for $15 to $20 per ton. According to another researcher, payments to refrigerant manufacturers, investors, and the government of China, where most projects are sited, will total approximately $5.3 billion, whereas the costs of these projects are likely to be less than $115 million.[56] While recently constructed plants cannot earn credits, some observers have raised concerns that the CDM will be extended to include new incineration sites. They argued that this could provide perverse incentives for plants to emit more, not less, as HFC-23 emitters could in theory earn much more by destroying these gases as they could from actually selling HCFC-22.

Some researchers have downplayed these concerns and identified several reasons why they do not expect problems to continue. It is unlikely, for example, that industrial gas projects would have been undertaken without the CDM. Further, these projects constitute a small and diminishing share of projects, primarily because the pool of cheap reduction opportunities has been largely exhausted. In addition, tax revenue from HFC-23 projects may boost sustainable development programs. In light of the CDM's experience with industrial gas projects, however, some researchers have suggested that certain greenhouse gases could be better addressed by other mechanisms.

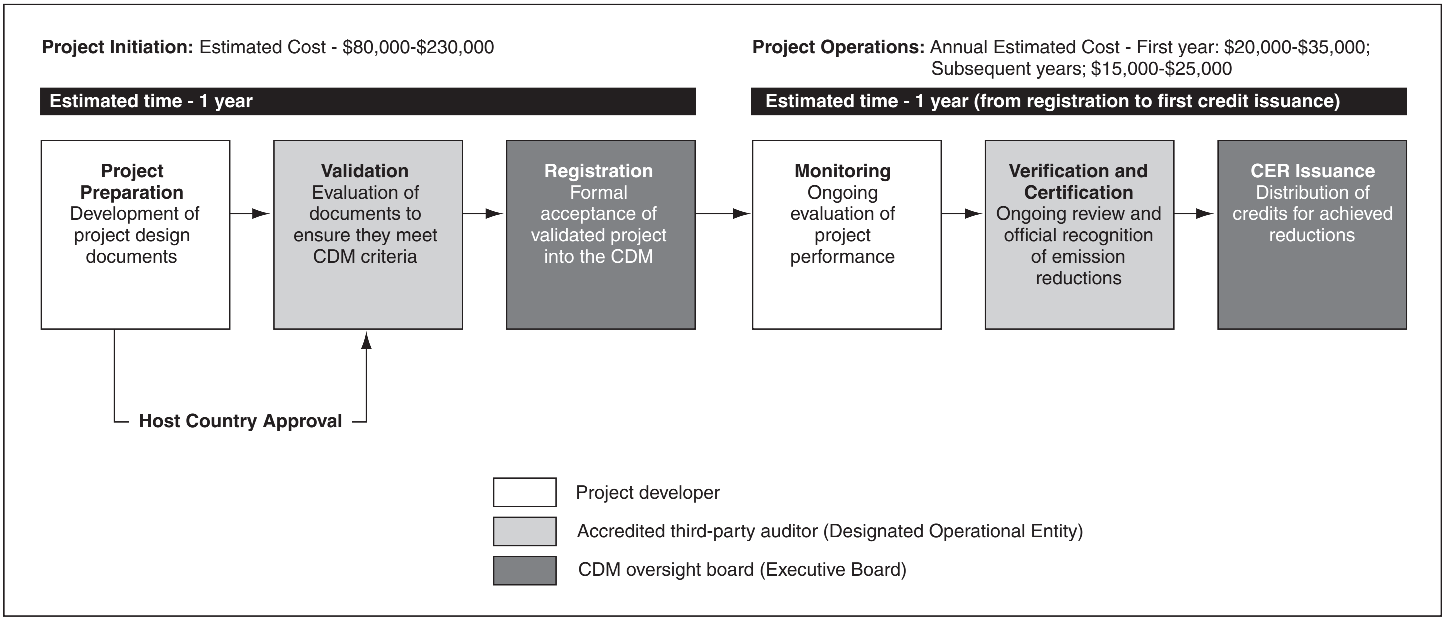
[56]Wara, Michael W. and Victor, David G., *A Realistic Policy on International Carbon Offsets* (Stanford, Calif., 2008).

Going forward, many believe the quality of projects will increase as the number of cheap, "low-hanging fruit" projects decreases. Indeed, current project trends have shown an increase in renewable energy and energy-efficiency projects, which have the potential to confer long-term sustainability benefits, and a decrease in industrial gas projects. However, given that CDM's market-based design encourages its participants to pursue low-cost projects, it may ultimately be difficult for the CDM, as currently structured, to make significant contributions toward sustainable development goals.

The Scale and Cost-Effectiveness of the CDM Is Limited by the Current Project-by-Project Approval Process, but Proposed Reforms Could Improve Its Effectiveness

The CDM's project-by-project approval process may not be a cost-effective model for achieving emission reductions. Most experts expressed dissatisfaction with this approach, which requires individual review and additionality assessments for each project. Observers also have described the project-by-project approach as inefficient, noting that the long, uncertain approval process can create risks and costs for investors (fig. 8 shows the resources and time associated with each step in the process). Host country stakeholders we spoke with generally agreed with this assessment, saying that the process was bureaucratic and overly burdensome. Indeed, the length and administrative complexity of the process, as well as the shortage of available emission verifiers, has resulted in bottlenecks and delays as the CDM's administrative structure has struggled to keep up with the number of projects. Moreover, the transaction costs and investment risks associated with CDM projects can reduce their effectiveness as a cost-containment mechanism when linked to compliance schemes.

Figure 8: CDM Project Cycle



Source: GAO analysis of UNFCCC documents and UNDP data.

While the CDM's intensive review process may help ensure some degree of environmental integrity, it also can limit the number of potential projects in the system. For example, the cost to initiate a CDM project and usher it through the approval process may be too high for certain projects, rendering them unviable. Some experts expressed concern that the CDM discouraged investment in the kinds of projects that would have the most benefits, because such projects are too costly, while others said that the extensive process does not necessarily result in a higher quality of credits. On the other hand, an Executive Board member we spoke with cited an unexpected but positive result of the delays. According to him, many projects waiting for approval have already been implemented but will not receive credits for emission reductions prior to registration; as a result, the number of credits issued to these projects may underestimate their environmental value.

According to some stakeholders, generating the additionality analysis required under CDM is especially time-consuming, and, in some cases, impractical. For instance, several host country stakeholders expressed frustration over the investment analysis component of additionality, which requires project proponents to demonstrate that the proposed project would not be financially viable without the revenue provided through the

CDM. They considered this requirement to be unrealistic, since the level of incremental CDM revenue is often too small to be the sole driver of investments, particularly in the case of multimillion dollar projects that have their own revenue stream, such as wind energy plants. Because some projects do not produce the number of credits that were initially projected, it is difficult for investors to know whether the projects will be profitable without the CDM. In addition, CERs are not issued until the project is registered and emissions have been verified, a process that can take several years, whereas the upfront financing for the project may be needed much earlier. Given these difficulties, one stakeholder involved in CDM finance said that their firm often prepares two sets of financial documents—one set for internal planning purposes, and another set that presents the data in a way that complies with CDM requirements. This stakeholder and others suggested that the ability to get projects approved depends largely on the ability to meet paperwork requirements, and said that paperwork is, in some cases, manipulated to artificially comply with rules that the project proponents think are unreasonable or restrictive. Several experts also claimed that the investment analysis requires auditors and Executive Board members who review this paperwork to make subjective decisions about the intent of investors.

A few stakeholders further commented that the current definition of additionality was too restrictive and overlooked other benefits of the CDM. Several felt it was unrealistic to account for every unit of emissions, recommending instead that the CDM simplify the requirements to let more projects into the system. A number of experts concurred with this position, saying that the effort to assess the exact emissions from each project was impossible and that an imperfect system was not a valid reason for inaction on climate change.

Indeed, under the current approach, it is unlikely that the CDM will significantly impact global emissions in the future. According to the International Energy Agency, global energy-related emissions are expected to increase approximately 57 percent from 2005 to 2030, with most of the additional emissions coming from China and India. This represents a major shift from the time period 1900 to 2005, when China's and India's historical share in cumulative emissions amounted to only 8 percent and 2 percent, respectively. In light of these trends, several experts highlighted the importance of involving developing countries in efforts to curb climate change. However, the scale of the CDM is limited not only by the extensive set of requirements; it also is constrained by the fundamental time and resource limitations of the 10-member Executive Board and its subsidiary panels, and the shortage of accredited auditing firms to validate projects and verify emissions. Even assuming all projects are real and additional, it is likely that reductions from these projects will only represent about 2 percent to 3 percent of annual energy-related carbon dioxide emissions in China and India, and less than 1 percent in Africa.[57]

The CDM is not intended to be the sole solution to climate change, but it is yet unclear whether it can play a significant role. As a number of experts mentioned, reductions from both the developed and developing world are needed in order to effectively address climate change. According to some of these experts, however, it is unlikely that offset programs, on their own, will be enough to help curb developing country emissions. However, others claimed that the CDM, if reformed or supplemented, could make a broader impact worldwide.

Experts provided a number of potential improvements to CDM, many of which would represent fundamental changes to the current mechanism's structure and procedures. Key themes underlying many of the experts' recommendations were a need to streamline and simplify the approval process and increase the CDM's effectiveness by targeting certain project types, industry sectors, or countries. However, the options presented below, are not necessarily exclusive of one another; in fact, many experts suggested a combination of approaches.

Sectoral CDM

Many experts recommended that the CDM move toward a so-called "sectoral approach," which involves crediting emission reductions in relation to baselines set for different economic sectors, such as the power sector or cement industry. For example, the aluminum and cement sectors could have benchmarks based on the best available technologies in the industry, and facilities that performed above the benchmark would receive credits. The advantage of such an approach is that it eliminates the need for project-specific determination of additionality, because credits are awarded based on performance in relation to a predetermined baseline. However, this approach requires reliable historic emissions data to set baselines and the technical capacity to monitor emissions, requirements which may prove problematic for some developing countries.

[57]Analysis uses country-specific emissions data from IEA, *Key World Energy Statistics* (2008) as well as data on expected CERs from the UNEP Risoe CDM/JI Pipeline Analysis and Database, Oct. 1, 2008. IEA data for each region are based on 2006 indicators and include emissions from fuel combustion only.

There are many different ways the sectoral approach could be implemented. For example, credits could either be awarded to private entities that reduce emissions below the baseline for their sector or to countries that implement policies that encourage or compel reductions in particular sectors. Sectoral baselines could be defined by intensity (emissions per unit of output) or set as an absolute cap.

Sectoral No-Lose Targets

A few experts also advocated the use of sectoral no-lose targets, in which tradeable credits are issued to governments that reduce sectoral emissions below a preset baseline. There would be no penalties if emissions exceed the baseline—the purpose of these targets is to mobilize investment in low-carbon technologies in developing nations. This approach is similar to the government-administered sectoral approach discussed above, except that the national sector-wide baselines would be negotiated at the international level instead of using the CDM's current institutions and processes. This would have the practical effect of eliminating additionality assessment from the process altogether, since the targets for industrialized countries in a post-2012 agreement would factor in the credits awarded through no-lose targets. However, some researchers have concluded that this approach would make emissions leakage more likely, since targets are not binding.

Programmatic CDM

Some experts that proposed reforms discussed the benefits of the programmatic approach, in which a group of small-scale activities is credited as one CDM project. In theory, this option helps promote projects that may result in significant emission reductions but may not be viable on an individual basis; for example, a program that provides energy-efficient lightbulbs to a significant number of households. The aim is to reduce the transaction costs involved in the CDM by distributing these costs over a group of activities, an approach that may be particularly beneficial for energy-efficiency projects. While programmatic CDM has already been approved for use, it has been applied in few projects to date. According to stakeholders we spoke with, this is partially because it is challenging to design a methodology to verify emission reductions on a programmatic scale—for example, it may be difficult and costly to take a sample of households in order to demonstrate that issued lightbulbs are being used and emission reductions are achieved. In addition, independent auditing firms are responsible for verifying these reductions, and may be reluctant to take on the added liability.

Positive Lists

Many experts recommended the use of positive lists, which involves creating a list of activities that have been approved as additional and are therefore eligible for CDM credits. Such a list could include projects that use specific technologies or are located in a particular geographic area. Projects that fall outside this list would then be subject to added scrutiny or excluded altogether. As with sectoral approaches, positive lists remove the need for in-depth, project-specific determination of additionality, reducing the risk and administrative burden of project approval. However, in the past it has proven difficult to negotiate the exact types of projects or methodologies that would constitute such a list.

Mandatory Caps

Several experts suggested a transition from CDM to mandatory emissions caps, particularly for countries with significant and growing contributions to global emissions. This approach would help distribute costs and control environmental outcomes, although many consider it to be an unrealistic expectation, especially in the short term. Emissions from industrialized nations have represented the vast majority of emissions to date, and developing nations may be unlikely to participate in agreements that significantly hinder their economic growth. One expert suggested that allotting generous caps to developing nations may help encourage their participation.

Discounting Credits

Due to the inherent problems in determining additionality, a few experts recommended discounting credits received through CDM projects. For example, with a discount rate of 30 percent, a project that is expected to reduce carbon dioxide by 100 metric tons would only receive 70 credits. While discounting may not help screen out nonadditional projects, it can help mitigate the environmental consequences of nonadditional credits. Some researchers have suggested using per capita emissions or income in host countries as a way to determine the level of discounts; others recommend discounting projects where environmental benefits are less certain. However, discounting may reduce the chance that additional projects, which rely on CER revenue to succeed, will be viable through the CDM.

Phasing Out Offsets

A few experts recommended avoiding the use of offsets altogether. According to them, offsets are a flawed method of achieving environmental and economic goals. A number of experts preferred the economic and environmental certainty of a firm emissions cap.

CDM Experience Offers Key Lessons Learned about Program Design and Implementation

The design of offset programs such as the CDM, and their use in compliance programs, can have important economic and environmental implications. In theory, an effective offset program reduces compliance costs but maintains overall environmental integrity; in practice, however, the CDM experience shows that this is a difficult goal to achieve. Using available information, stakeholder interviews, and our experts' responses to the questionnaire, we have identified lessons learned to help inform congressional deliberations on climate change legislation and the use of offset programs. The lessons outlined below focus on three essential areas—the cost-effectiveness of CDM projects, their environmental effects, and the tradeoffs involved in incorporating either the existing CDM program or an improved version into future U.S. climate change mitigation programs.

Cost-Effectiveness

The experience of the CDM has provided a number of lessons about the costs and economic efficiency of offset programs. One of the most obvious benefits of such programs is that they can help decrease the cost of complying with emissions targets. However, this also may be a disadvantage, if the price of carbon does not reach levels high enough to promote fundamental technological changes needed to mitigate climate change. In addition, emission reductions achieved through the CDM may not always be cost-effective, especially in the case of industrial gases such as HFC-23. Because the cost to implement these projects is a fraction of the projects' overall credit value, several researchers have concluded that it would be more efficient to fund these types of projects through more direct means.

Moreover, the current project-by-project approval process imposes extensive time and resource requirements on CDM participants, and the associated transaction costs may further diminish the overall cost-effectiveness of the program, according to many of our experts. There is a fundamental tension between minimizing costs and maximizing the quality of offset projects, and our analysis suggests that the CDM is not reliably effective in either area. Some stakeholders and experts said that high transaction costs weed out the very projects that would benefit most from CDM revenue—high-cost projects that involve fundamental technology changes. In addition, one expert told us that the cost and risk associated with navigating the CDM process diverts much of the proceeds from selling CDM credits to project financers and verifiers in the developed world. These concerns highlight the importance of considering the cost-effectiveness of achieved emission reductions in addition to the ability of offsets to lower compliance costs.

Environmental Effects

A key requirement of offset programs is that issued credits represent real and additional emission reductions. If this condition is not fulfilled, the use of offset credits in mandatory emission reduction programs can undermine the environmental integrity of efforts to meet emissions targets. In theory, if all offsets were real and additional, the use of these offsets in a mandatory emissions scheme simply shifts the location of the emission reductions and would not negatively affect the scheme's integrity. However, as many experts mentioned, it is nearly impossible to demonstrate project additionality with certainty. Researchers have reported that some portion of projects registered under the CDM have not been additional, and although there is little empirical evidence to support a precise figure, some studies have concluded that a substantial number of nonadditional projects have received credits.[58] As previously indicated, a significant number of nonadditional projects can introduce uncertainty about the level of reductions or even compromise the environmental integrity of a program—such as a cap-and-trade scheme—that enables the use of offset credits. For example, if CDM credits can be used in on a 1:1 ratio, and not all CDM credits are additional, then emission reductions may be less than the scheme intends.

The CDM's oversight board has taken a number of actions to help improve the process over time, but many experts maintained that the program does not yet provide a sufficient level of quality assurance. Moreover, the intensive project-by-project review process used by the CDM significantly limits the number of projects and the overall scale of the program, making it unlikely that the CDM, as currently structured, will achieve large-scale reductions. While the design features of an offset program such as the CDM can be fine-tuned to help maximize their effectiveness, the underlying challenges of determining additionality, for example, may not be eliminated completely.

Some research has advocated limiting the use of offsets in compliance schemes as a way to reduce the environmental risk of nonadditional projects; however, our research shows that even restricted offset use can have broad environmental implications. In particular, the experience of the ETS illustrates the importance of considering offset limits in the context of a country's overall reduction effort, in addition to its overall emissions target. As noted previously, limiting offsets based on the overall emissions cap—for example, allowing countries to meet 12 percent of

[58]For example, one study analyzed documentation from 93 projects that were registered from 2004 to 2007, and concluded that additionality was questionable in approximately 40 percent of these projects. However, the author notes that this figure is based on past performance and does not reflect recent improvements to the approval process. See Schneider, Lambert, *Is the CDM fulfilling it environmental and sustainable development objectives? An evaluation of the CDM and options for improvement* (Berlin, Germany, 2007).

their emissions cap with offsets—may mean in practice that most or all reductions occur outside of that country's borders. If most reductions occur elsewhere, there may be little incentive for entities under the compliance program to make infrastructure changes or other technological investments. Furthermore, the negative environmental effects of nonadditional offsets increase as the number of imported credits rises. On the other hand, stringent limits can ensure that a certain portion of abatement activity occurs at home and help secure a carbon price that is high enough to spur investment in low-carbon technologies; limits also can lessen the impact of nonadditional credits. If limits are imposed, therefore, it is important that such limits are sufficiently stringent and are based on actual expected emission reductions, not the overall emissions cap.

Tradeoffs and Potential Improvements

There is general consensus among climate change experts that both industrialized and developing countries must be engaged in emission reduction efforts to meet goals established by the UNFCCC. In light of these circumstances, several experts we consulted noted that international offset programs such as the CDM can help to engage developing nations and encourage emission reductions in areas that may not otherwise have incentives to do so. In fact, because the CDM provides one of few such incentives, some experts expressed concerns about eliminating the program without a practical alternative to take its place. Further, several experts said that the CDM helps stimulate interest in international climate change dialogue and may help facilitate progress toward future emission reduction commitments.

However, using the CDM to engage developing countries and promote emission reductions also can present tradeoffs. While the CDM may encourage these countries to participate in emission reduction activities, it also may increase their reliance on external funding for such activities. According to several experts, in fact, the CDM effectively deters efforts that fall outside the scope of creditable activities. Moreover, as many of our experts pointed out, the concept of additionality presents a difficult regulatory problem. Rigorous project reviews may help ensure some degree of credit quality, but also can increase the overall cost of the program. Overall, many experts suggested that the CDM has not yet achieved an effective balance of these priorities.

Given these tradeoffs, many experts provided recommendations to help improve the program. These recommendations, discussed previously, ranged from small adjustments in the CDM's approach to more fundamental shifts in the approval and crediting process. Important themes underlying these recommendations included a need to improve the environmental integrity of projects, to simplify the project approval process by moving away from the project-by-project approach, and to promote certain types of projects, such as those in which emission reductions are easily measured or that confer substantial sustainable development benefits. Most experts recommended a combination of approaches between and within countries, because the ideal mix of tools for transition economy countries is unlikely to be suitable for small and less-developed countries. Such reforms have the potential to increase the CDM's value as a cost-containment mechanism and its ability to make meaningful contributions to environmental goals.

However, while improvements to the CDM may help to streamline the program and address quality concerns, offsets may be a temporary solution at best, according to several of our experts. According to some observers, the best approach may be to gradually incorporate developing nations under a global emission reduction plan or move toward full-fledged, worldwide emission trading, given that emissions caps provide greater environmental certainty than offset credits. However, political and institutional capacity may make this an unlikely possibility. As a result, the CDM may be best used as a transition tool to help developing nations move toward a more comprehensive climate change strategy.

Concluding Observations

Understanding the lessons learned from the international experience with the ETS and the CDM provides the U.S. Congress with an opportunity to draw on this experience as it considers legislation intended to limit emissions of greenhouse gases. While the ETS and the CDM are the largest existing international programs to address climate change, they are very different programs with unique strengths and limitations. Nonetheless, both programs provide insights into important program design and implementation issues that are central to the climate change policy proposals currently under consideration in the United States. Specifically, the lessons learned from the ETS—the importance of reliable data on emissions, the need for long-term certainty, and the impact of allowance allocation on wealth transfers—relate directly to the development of a domestic cap-and-trade system, which has already been considered on the floor of the U.S. Senate. Similarly, considering the lessons learned from the CDM—that it may be possible to achieve the CDM's goals more cost-effectively through other means, that carbon offsets are inherently uncertain and can potentially undermine the integrity of a cap-and-trade scheme, and that potential reforms, while promising, may not address fundamental tradeoffs—may prove useful in informing congressional deliberations over the use of CDM credits or other types of carbon offsets in domestic climate change programs.

Matters for Congressional Consideration

In deliberating legislation intended to limit greenhouse gas emissions that would employ a cap-and-trade system or allow the use of carbon offset programs such as the Clean Development Mechanism, Congress may wish to consider the lessons identified above to help ensure that it develops policies that achieve the intended results in a cost-effective manner.

Specific lessons from the ETS that the Congress may wish to consider include: (1) the importance of ensuring the availability and reliability of historic emissions data, with an accuracy compatible with the program's point of regulation, from entities that will be affected by the regulatory scheme prior to its establishment; (2) the importance of long-term certainty in encouraging investments in low-carbon technologies; and (3) the importance of understanding how the means of distributing allowances to emit greenhouse gases—such as free allocation versus auctioning—may create and redistribute substantial wealth.

Specific lessons from the CDM that the Congress may wish to consider include: (1) that it may be possible to achieve the CDM's sustainable development goals and emissions cuts in developing countries more directly and cost-effectively through a means other than the existing mechanism; (2) that the use of carbon offsets in a cap-and-trade system can undermine the system's integrity, given that it is not possible to ensure that every credit represents a real, measurable, and long-term reduction in emissions; and (3) that while proposed reforms may significantly improve the CDM's effectiveness, carbon offsets involve fundamental tradeoffs and may not be a reliable long-term approach to climate change mitigation.

As agreed with your offices, unless you publicly announce the contents of this report earlier, we plan no further distribution until 30 days from the report date. At that time, we will send copies to other interested parties. In addition, the report will be available at no charge on the GAO Web site at http://www.gao.gov.

If you or your staffs have any questions about this report, please contact me at (202) 512-3841 or stephensonj@gao.gov. Contact points for our Offices of Congressional Relations and Public Affairs may be found on the last page of this report. GAO staff who made major contributions to this report are listed in appendix IV.

John B. Stephenson
Director, Natural Resources
and Environment

Appendix I: Objectives, Scope, and Methodology

To address the two objectives, we employed a two-step methodology. In the first step, we identified program effects through a review of available data and literature and conducted a series of semi-structured interviews with Emissions Trading Scheme (ETS) and Clean Development Mechanism (CDM) stakeholders to better understand program implementation. Specifically, we (1) reviewed relevant emissions trading literature, including academic reports, legal documents, and economic assessments; (2) obtained empirical evidence from the economic literature and available data sources, determined the data were sufficiently reliable for this report, and analyzed the data to identify impacts on emission reductions, technology innovation, competitiveness, and sustainable development; (3) met with U.S. and international stakeholders including government officials from the European Commission, the Designated National Authority of India, China's CDM Fund, the Kyoto Protocol's CDM Executive Board, and the U.S. Department of State, as well as representatives from industry groups, environmental groups, market traders, researchers, and other participants in the CDM (project owners, developers, and auditors); (4) considered the U.S. administration's perspective on the ETS and the CDM by meeting with the Council on Environmental Quality; and (5) conducted a site visit to a CDM offset project in China. We selected stakeholders that had significant levels of expertise in the ETS and CDM programs, including some stakeholders with direct involvement in the implementation of these programs. The CDM project we visited was selected based on interviews with project developers, who also coordinated our visit to the project. The project, which utilized waste gas from an iron and steel plant to generate electricity, was fairly representative of a typical CDM venture in terms of its location, size, and emission reduction methodology.

For the second step, we obtained expert opinion on the implications and lessons learned for U.S. policymaking using a virtual panel on the Internet. To gather expert opinions from the experts, we employed a Web-based questionnaire that was developed based on the results of the data collection efforts in the first phase. By using a Web-based process, we were able to overcome some of the potential biases associated with group discussions. These biasing effects include the potential dominance of individuals and group pressure for conformity. Moreover, by creating a virtual panel, we were able to include more experts than would have been possible with a live panel. While the method has these strengths, there are some potential limitations. For example, there is considerable reliance on the experts completing the questionnaire, as some may complete only limited sections, or not respond at all. In addition, the results of the questionnaire are limited to the issues and topics generated by our initial data collection efforts. To mitigate the latter limitation, we added generalized open-ended questions that provided an opportunity for experts to comment on topics not directly addressed by the questions. Lastly, because this was not a sample questionnaire, it has no sampling errors. However, the practical difficulties of conducting any questionnaire may introduce errors, commonly referred to as nonsampling errors. For example, difficulties in interpreting a particular question, sources of information available to respondents, or entering data into a database or analyzing them can introduce unwanted variability into the results. We took steps in developing the questionnaire, collecting the data, and analyzing them to minimize such nonsampling errors.

We contracted with the National Academy of Sciences (NAS) to select and recruit a panel of experts with a range of experience in both market-based climate change programs and U.S. policymaking. Participants were to have (1) expertise in market-based tools used to address environmental problems, both in the United States and abroad; (2) familiarity with potential distributional effects of an emissions trading policy, for example, distribution of costs across different industries; (3) expertise in evaluating the performance of policies as well as knowledge of climate change agreements, politics, and policies, both at the international level and in the United States; and (4) an understanding of the implementation of U.S. environmental policies. To select the experts, we provided NAS with a list of potential experts that we identified in our review of the literature. In collaboration with NAS, 31 experts who met our criteria were identified. NAS sent these individuals an electronic letter via e-mail inviting them to participate in the study along with a description of the project. Of the 31 experts NAS recruited to participate, 29 agreed and were sent the questionnaire. Twenty-six ultimately completed the questionnaire. All of the experts who participated completed a form stating that they had no conflicts of interest that would compromise their ability to participate in the questionnaire.

Prior to the posting of the questionnaires, we conducted pretests with two panel participants. The goals of the pretests were to check that (1) the questions were clear and unambiguous and (2) terminology was used correctly. We made changes to the content and format of both questionnaires as necessary during the pretesting processes. We also conducted usability tests of both questionnaires for the Internet to ensure operability. The final version of the questionnaire was posted on the Internet, and experts were notified of the availability of the questionnaire with an e-mail message. The e-mail message contained a unique user name and password that allowed each respondent to log on and fill out a questionnaire but did not allow respondents access to the questionnaires of others.

In the questionnaire, we asked experts to provide responses to 17 closed- and open-ended questions on the effects of the European Union ETS and CDM, and implications for U.S. policymaking. In particular, we asked experts to comment on: effects of the ETS, such as abatement and competitiveness; extent to which particular design elements, such as methods to distribute allowances, influenced ETS results; effects of the CDM, such as on emissions, sustainable development, and technology transfer; and implications of lessons learned for design and implementation of U.S. program to reduce greenhouse gas emissions.

Experts had approximately 4 weeks between August 2008 and September 2008 to complete their questionnaires. We followed up by email and phone to those who had not responded by our initial deadline of August 27, 2008. In some cases, we also asked several follow-up questions requesting that experts clarify their responses or elaborate on critical policy issues. In order to analyze the open-ended questions, we performed a content analysis of each expert's response and grouped these responses into overall themes. GAO provided a summary of the findings of this report and briefed representatives from the European Commission and the CDM Executive Board prior to issuing this report. The views expressed by the panel members do not necessarily represent the views of GAO.

We conducted our work from October 2007 to November 2008.

Appendix II: Summary of Joint Implementation

Joint Implementation (JI) is the third market-based mechanism established by the Kyoto Protocol to assist industrialized countries in meeting their emissions targets under the Protocol. JI allows countries with binding targets under the Protocol to generate credits, called Emission Reduction Units (ERU), by implementing projects that reduce emissions in other countries that have binding Kyoto targets. For example, a company in Finland could earn credits by developing a low-emission power plant in Russia and use these credits to comply with its ETS cap. JI projects are most likely to take place in eastern European economies in transition, where there are opportunities for emission reductions at lower cost than in other countries with binding Kyoto targets.[1] JI projects, like CDM projects, must be verified for additionality before they are approved and ERUs can be issued. Project verification can take two possible courses: review by the host country if the country satisfies certain eligibility requirements, known as Track I, or review by the JI Supervisory Council, known as Track II. While the processes of each host country's Track I procedure can differ from the process of Track II, the issuance of ERUs in both cases is the responsibility of the country hosting the project.

The JI market is significantly smaller and less mature than the CDM market and to date, no ERUs have been issued. As of October 2008, the volume of credits being verified under JI—i.e. in the pipeline—is approximately 11 percent of the volume of credits in the CDM pipeline. Under JI, a total of 158 Track II projects and seventeen Track I projects have been submitted in thirteen different host countries.

The JI market is smaller than the CDM market in part because it was implemented at a slower rate and covers a shorter time span. For example, the JI Supervisory Council was established in 2006, 5 years after the establishment of the CDM Executive Board. Moreover, CDM projects may receive credit for certain emission reductions occurring since January 1, 2000, whereas JI projects may only receive credits for emission reductions occurring since beginning of the Kyoto commitment period, January 1, 2008. The time and resources required to develop host country procedures for JI as well as uncertainty over the role of ERUs in a potential future climate agreement, have limited its impact to date. Although market

[1] Annex B of the Kyoto Protocol identifies 13 economies undergoing the process of transition to a market economy: Bulgaria, Croatia, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, the Russian Federation, Slovakia, Slovenia, and Ukraine.

analysts anticipate the verification of additional JI projects and ultimately the future issuance of ERUs, the outlook for the JI market is thus unclear.

Appendix III: Panel of Experts

Joseph Aldy, Resources for the Future
Robert Bailis, Yale University
Bruce Braine, American Electric Power
Barbara Buchner, International Energy Agency
Dallas Burtraw, Resources for the Future
Frank Convery, University College Dublin
David Doniger, Natural Resources Defense Council
David Harrison, National Economic Research Associates
Barbara Haya, University of California-Berkeley
David Hunter, International Emissions Trading Association
Nathaniel Keohane, Yale University
Joe Kruger, National Commission on Energy Policy
Franz Litz, World Resources Institute
Jennifer Macedonia, JLM Consulting
Brian Murray, Nicholas Institute for Environmental Policy Solutions, Duke University
Ken Newcombe, formerly of Goldman Sachs Center for Environmental Markets
Lydia Olander, Nicholas Institute for Environmental Policy Solutions, Duke University
Ronald Oppenheimer, Global Commodities, Merrill Lynch Commodities
Misato Sato, Electricity Policy Research Group, University of Cambridge
Anne Smith, CRA International
Margo Thorning, American Council for Capital Formation
Thomas Tietenberg, Colby College
Richard Tol, Economic and Social Research Institute
Mark Trexler, EcoSecurities
Michael Walsh, Chicago Climate Exchange
Michael Wara, Stanford University

Appendix IV: GAO Contact and Staff Acknowledgments

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Staff Acknowledgments

In addition to the contact named above, Michael Hix, Assistant Director; Kate Cardamone; Cindy Gilbert; Jessica Lemke; Alison O'Neill; Jeanette Soares; and Ardith A. Spence made major contributions to this report. JoAnna Berry, Jason Burwen, Richard Johnson, Susan Offutt, and Katherine Raheb also made important contributions.

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